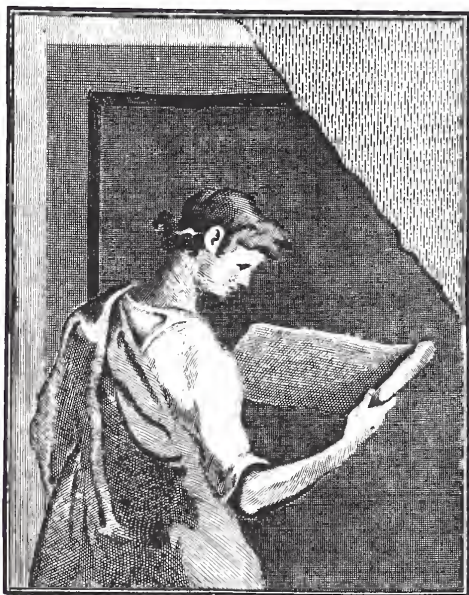






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INTRODUCTION.

IN assuming the Editorial responsibility of the *Mechanics' Magazine and Engineers' Journal*, it would seem but proper, and in accordance with established custom, to devote some space to a brief exhibit of the aim and scope of the work; this, however, has been rendered in a measure unnecessary by the copiousness of the Publisher's prospectus, which has been before the public now for some months, and to which we beg leave to refer the reader.

The plan of the work has been so far modified from that indicated, as to make the publication monthly instead of weekly; this has been done with a view to admitting a more complete system in the subdivision and arrangement of the parts, and, it is believed, enhancing its value to all readers without increasing its cost.

Each number will embrace five heads or sections, in the following order, viz:

MECHANICAL SCIENCE.

Descriptions of machines, or valuable inventions, foreign and American, which require illustration, and which will be exhibited on a scale as large as the page will admit;—also,

Scientific papers, practical views, reports or contributions, or queries in any branch of mechanical science or art, including discussions relating thereto, illustrated if necessary.

MISCELLANEOUS.

Miscellaneous extracts from scientific journals.

REVIEWS.

Reviews of scientific works, American and foreign, and notices of engineering

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or architectural constructions, in progress or completed.

PATENTS.

Notices of American patents with their specifications, and a list of those issued during the month.

Notices of foreign patents, with a list of those registered during the month.

CORRESPONDENCE.

Notices to correspondents.

Our object being the spread of scientific knowledge, we confidently look to the lovers of it for the aid of their contributions.

We solicit the correspondence of the man of leisure and the operative; accounts of discoveries, inventions, or improvements; descriptions or reports of public works, or private works of a public interest; new machines, or useful machines not generally known; details of experiments in any branch of natural science; and our pages will always be open to communications or discussions on any subject embraced within the scope of the work.

Valuable correspondents both at home and abroad have already been secured, and we may hope to render the Magazine instructive to all classes for whom we labor.

We ask the indulgence of our foreign subscribers for a season, and until our arrangements are thoroughly perfected for securing an early notice of whatever of value in the mechanic arts is transpiring among us.

Foreign scientific journals abound in matters of deep interest to us, and no apology is necessary for gleaning liber-

ally from among them for the benefit of our home readers; while, on the other hand, the results of American workshops must be sought in the shops themselves; and hence the supply of home material will bear a direct ratio to the strength of our corps of contributors and agents, which we trust will be continually augmenting commensurately with our personal efforts to enlist them.

To our readers generally, and such as are interested in the objects of this publication, as exhibited in the prospectus of the Publishers, it is unnecessary to enlarge upon the benefits to be derived from a universal diffusion of scientific knowledge; but aware of the *distrust*, to call it by no stronger term, which exists in the mind of many towards whatever purports to be "scientific," or "theoretical," we may be permitted a few brief remarks for the benefit, mainly, of the unbelievers in "Theory."

The term "theoretical" is used among mechanics generally, as distinctive of investigations which have not for their basis the *known* relations and conditions of matter, but the *assumed*; now the theory of an art or science embodies, of course, all the truth known of it, yet our knowledge is so limited that there still remains room, in most cases, for *hypothesis*; and it is this latter, which, being too frequently confounded with theory, has led to the distrust entertained of it by practical men; seemingly supported by the common remarks of even sensible persons, that such a thing "may be true in theory, but wrong in practice." An encyclopædia of science and art now before us, defines theory thus: "Theory in general denotes any doctrine which terminates in speculation alone, without considering the practical uses and applications thereof."—We define it as—generalized practice, or the results of experience reduced to system and embodied in general language.

Much misunderstanding, it would seem, exists on this subject, and as we profess to cater for both the theoretical and practical man, and assume that their aims are in fact, or should be, identical, we are interested in showing that each class is mutually dependent upon the other.

We cannot do better, in illustrating our views on this head, than to quote

an article from the "Glasgow Practical Mechanic and Engineer's Magazine," a work of great practical utility, to which we shall occasionally refer.

THEORY AND PRACTICE.

"We have two useful classes of men—the theoretical and the practical—between whom a contest for precedence has long existed. The contest is usually regarded as of little moment; and, it must be admitted, that there would hardly be a plea for interfering, were it not that their mutual jealousies defraud us of no small amount of their several contributions to the stock of our knowledge. It is on this account not an entirely harmless contest, nor are the depreciatory opinions entertained of each other without their injurious effects.

"The true distinction which is to be recognized between theory and practice, as terms of language, is, that practice describes a set of operations which have not been methodized and reduced to a systematic form. Theory, on the other hand, is the name under which a class of operations is generalized, and their principle enunciated. While practice indicates a certain mode of action, theory points out the most correct way. And, if this be correct, our next conclusion is, that practice, unaided by theory, has only a *chance* of being right; whereas theory can never be wrong; and that practice, which is not entirely in accordance with theory, must be erroneous.

"It must be allowed that this is rather the strict meaning of the term than the signification which it is often made to bear. But the employment of it to denote that sort of philosophical guess-work called *hypothesis* is unphilosophical, although often *practised*. Hypothesis and theory are essentially different; the hypothesis *may be* correct, but the theory *is* essentially true. What is false has no place in theory, and can form no element of theoretical knowledge.

"Every practical mechanic, and indeed every member of society, whatever may be his position, has then an interest in the extension of theoretical knowledge. Theory is the model to be taken for imitation, and it is upon this imitation that all dexterity is founded. If the process as a process of art be new, the model may not have been brought under actual observation; but it must exist in the mind. It may there be mixed up with hypothesis, and, to that extent, it is doubtful. To imitate what has been done before is practice, but there is a disposition in the mind to surpass this imperfect sampler; for all human operations, even the best performed, fall short of abso-

lute correctness. But whatever extends beyond the degree of accuracy with which like work has been previously performed, is theory. Practice goes no farther than human ingenuity has previously done. It stops short when it has reproduced the work, with all the imperfections of the model; and beyond the degree of accuracy necessary to accomplish this it cannot proceed, without taking a theoretical model as the object of imitation. No practical man, if he harbor the slightest desire for improvement in his operations, can therefore avoid theorizing, however unconscious he may be of the mental process applied. All that admirable accuracy, which characterizes the tools of the work-shop—all those improvements in the arts of which we are so justly proud—all that delicacy and beauty of workmanship which we point to with exultation—all that skill and dexterity, all that knowledge and ingenuity, which the products of our industry exhibit, are the results of that quenchless thirst for theoretical knowledge which actuates the mass of society as one common motive.

"Beyond the facility of repeating what has been imperfectly done before, practice does not go. It stops short when it has brought the muscular action under that control which is necessary to the performance of a class of often repeated operations. The moment we take our position on higher ground—that moment we step beyond the training of mere habit; practice becomes theoretical, and a new impulse is given to improvement. Facility of operation once attained, the man who is familiar with the theory of the operation—he who compares the results of his labor with other results, and discovers the connection of the particular operation to which it belongs—is in a condition to apply his dexterity more extensively, and with increased effect. He becomes, in consequence, a more valuable workman, and, rising in the scale of intelligence, he sets up a model for practice which may stimulate to further and higher improvements. Following up the sleepless principle of his nature, he stamps upon his art the impress of his intellect, and takes his place as a benefactor of his race.

"There is a feeling, indeed, that the practical mechanic has become, by the progress of improvement, a mere tender of machines; and, therefore, requires little more intelligence than to know the order of the wheels, pulleys, levers, and cranks, under his superintendence. Nothing can be more wide of the truth, and no opinion, were it acted upon, could be more hurtful to the progress of society. Machines are the tools by which

we employ the powers within us, and the external powers which nature has placed at our disposal. It is the governing hand of man which infuses usefulness into their movements. And although many of them are excellent, yet few can be pronounced beyond the reach of improvement, and still fewer can be ranked as perfect. And there is still an ample field in their forms of construction, and the accuracy of their workmanship. And here theory is the only guide. Its deductions may not, in practice, be realized in full, but the more nearly we approach that point, the more closely do we approximate to perfection.

"It is, then, manifestly impossible to separate practice from theory, without relinquishing every prospect of advance, and every hope of amelioration. Theory is the basis of all progress, and the disrepute in which the term has been held by practical men—all theorists, nevertheless)—has, in some measure, arisen from its placing models before him which he found it was impossible at a first trial to copy. He forgets that, but a few years ago, the common operations of the lathe and the planing-machine, which are now within the range of his every-day practice, were reckoned unattainable. They were then theoretical; they are now illustrations of the advantage which practice reaps by following in the path of theory. Railways, and all the ideas we associate with them, existed but a few years back in theory, and the whole aggregate achievements of the steam-engine are but so much practice, derived almost wholly, within our own recollection, from the deductions of theory.

"It frequently indeed happens, that theories propounded by non-practical men are defective, are wanting in some of their important elements. Such propositions are, however, incorrectly called theories, for theory must ever be perfect. It belongs, therefore, to the practical man to correct these so-called theories—take from them those elements which are valuable, and which he has overlooked in his practice, and ingraft them upon his own stock of knowledge. It is in his hands that theory becomes useful, and he deprives himself of much of the means of advancing himself and his art by continuing to treat with disdain all deductions of a scientific kind, because they have not, hitherto, been reduced to practice. It is, moreover, upon the data which his art furnishes that a theory of his operations can be founded. He ought not, therefore, to blame the merely theoretical inquirer because he has failed to incorporate every element of the investigation. He is unworthy the name of a theorist

if he has not made good use of the materials which he has collected, and where the deficiency occurs the practical man must supply the omission. This function, however, implies in the practical man more than mere practice—it implies a knowledge of the theoretical truths upon which his practice is founded.

“In strictness, theoretical knowledge ought not only to be the foundation of all practice, but it ought to be regarded as such, and acquired as such by the practical man. Superior success in every operation he undertakes, depends upon the extent to which he succeeds in taking theory as his guide; and failure as certainly marks his ignorance or neglect of the injunctions which it imposes. Nothing could be more at variance with truth, than the supposition that practice stands out alone, and distinct, and independent of all principle—of all theory. Besides, there are, as yet, but few of our arts—advanced as they confessedly are—in which we can affirm that progression has taken the last step. We cannot, indeed, assert that we have gained a full knowledge even of the properties of the vapor of boiling water, and it is even possible that a time may come, when all our boasted achievements in locomotion, on land and water, shall be regarded as the feeble and partial attempts of dawning knowledge. The announcement that a new power had been developed and bequeathed to art by science, is hardly yet dry upon the pages of our journals. Little progress has hitherto been made in the applications of electromagnetism; but this is no argument that it is a supernumerary and useless bequest. The power is given, and it now belongs to practice to render it applicable and beneficial to man. If it be true, that no function and no property have been given to matter needlessly, we have much reason to hope, that under the strong dominion of man’s intellect, it will be made to put forth its energies for his advantage and in his service; and until we are certain that the final step has been taken, there is room for improvement and scope for theorizing.

“But while we blame the conduct of the practical man who makes a pretence of despising the labors of the theorist, we have likewise a word of admonition to those who would set up theory as something sacred—something that must only be approached by those who have passed through an extended curriculum of mathematical study. ‘A little learning,’ they tell us, ‘is a dangerous thing,’ and ‘shallow draughts’ of knowledge are worse than ignorance. But with all due deference to ‘college lore,’ we would ask whose ‘learning’ is not ‘little,’ and whose ‘knowledge’ is not ‘shallow?’ The ability to read and apply the formulæ in which the theorist gives forth the results of his investigations, may not be very intelligible to the practical mechanic; yet he has a thousand truths in store, which he understands better, and comprehends more thoroughly, than abstract theory can ever hope to expound. There are, moreover, but few theories which bear the stamp of perfection—few are entirely complete. There is some element assumed, or some element wanting. Bodies are assumed to be perfect in the properties assigned to them—practice finds these properties mixed up with others, which find no expression in the theory propounded. It is in the valuation of these mixed qualities that the superiority of practice consists, and, in the estimation of these, practice will be superior to abstract theory, until these so-called irregularities are brought within the range of calculation.”

Such is “our theory,” and we again earnestly invite all who think with us, to aid by their contributions in the extension of true knowledge, theoretical and practical. And while our best efforts shall not be wanting to lay before our readers whatever of valuable may be gathered, either in our own country or abroad, we shall consider ourselves and our labors but as the cement which binds the stones of an edifice together—however good it may be in itself—no man builds a house of it.

THE EDITOR.

APPLETONS'
Mechanics' Magazine and Engineers' Journal.

VOL. I.]

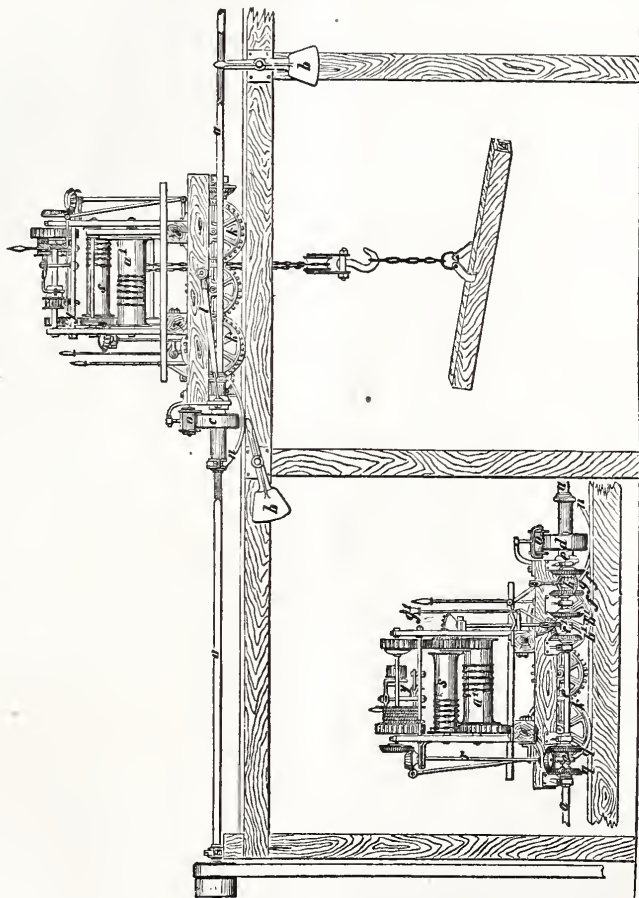
WEDNESDAY, JANUARY 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 1.

MNICOLL & VERNON'S PATENT STEAM TRAVELLING CRANE.

Fig. 1.



M'NICOLL & VERNON'S PATENT STEAM TRAVELLING CRANE.

From the London Artizan.

THE Travelling Crane, although an introduction of recent date, has proved such a convenient auxiliary in the multifarious operations involving the lifting and removal of heavy weights, that its use has spread very rapidly, and it is now to be found in almost every situation where it is applicable. In the erection of all large buildings, docks, &c.; in engine shops, like those of Woolwich Dock Yard and Swindon, and in those of several private firms, the Travelling Crane effects an important saving, although worked by manual labor. How much greater then will be the economy, both of time and money, obtained by the use of steam power, in place of the numerous men at present employed! The problem of its application to this purpose has been satisfactorily solved by Messrs. McNicoll & Vernon, of Liverpool, at the saw-mills of the former of whom two Steam Travelling Cranes may be seen in constant operation.

We saw one of these machines performing its ordinary daily work, and its most striking feature is the remarkable ease with which it can be made to perform all its movements. It is worked by a youth of 16 or 17 years of age, who stands on the platform, and by moving two or three handles is able to lift weights varying from 1 to 5 tons, to put them on or take them off carts or timber carriages, pile them one upon the other, or convey them from one side of the yard to the other, a distance of 127 feet. This distance might of course be increased to twice or three times the length, if the amount of work required it, and the premises were of sufficient extent.

The amount of work that these machines will perform, and the consequent saving in wages which they effect, are truly surprising. One of them has displaced two of the ordinary hand travelling cranes. The latter employed 4 men each, 3 men on the platform to hoist, &c., and 1 man below to fasten on the logs, in all 8 men, at 16s. per week each, or £332 16s. per annum. The patent steam crane is worked by a youth at 10s. per week, and a man fastening the logs to the hooks or chains, at 16s. per week, or £67 12s. per annum. Thus the one machine not only effects a saving of

£265 4s. per annum, but does the work of the two cranes which it displaced, doing it, at the same time, in a much more efficient manner.

The following experiment, which was performed on the 26th of July last, will enable persons to form an accurate idea of its capabilities. Thirteen logs of timber, containing 1050 cubic feet, were piled in a cress at one side of the yard. A plot of ground on the opposite side of the yard, 100 feet distant from the place where the timber was lying, was cleared, in order that the timber might be removed from the former and piled on the latter place. At one o'clock precisely the crane started, travelled 100 feet where the timber was lying, hoisted a log, returned to the place from whence it started, and deposited it on the ground in exactly 2 minutes. It immediately proceeded on a second journey, and at precisely 4 min. 10 sec. after one o'clock it deposited the second log. The remaining logs were, one by one, conveyed over the distance, and in 27 min. 30 sec. the logs had been removed and piled in a cress at the opposite end of the yard. The average weight of the logs was 30 cwt., the total weight $19\frac{1}{2}$ tons, allowing 54 cubic feet to the ton. The machine had travelled 2600 feet, or within 40 feet of half a mile, for half the distance carrying a load of 30 cwt., in addition to its own weight, besides having made 26 stoppages. During the whole of the operation only two persons were engaged,—the youth who directed the machine, and the man who fastened on the logs.

This experiment has been repeated several times, and the time occupied has never exceeded 27 min. 30 sec. On one occasion it was performed in 26 minutes. To those persons conversant with the difficulty and expense that, under ordinary circumstances, attend the removal and piling of so bulky an article as timber, the result of this experiment will appear startling, as the wages of the two persons employed could not exceed sixpence for half an hour's work.

This machine, like the ordinary hand travelling crane, moves upon a tram road laid upon longitudinal beams, raised from 15 to 20 feet above the level of the ground,

Fig. 2.

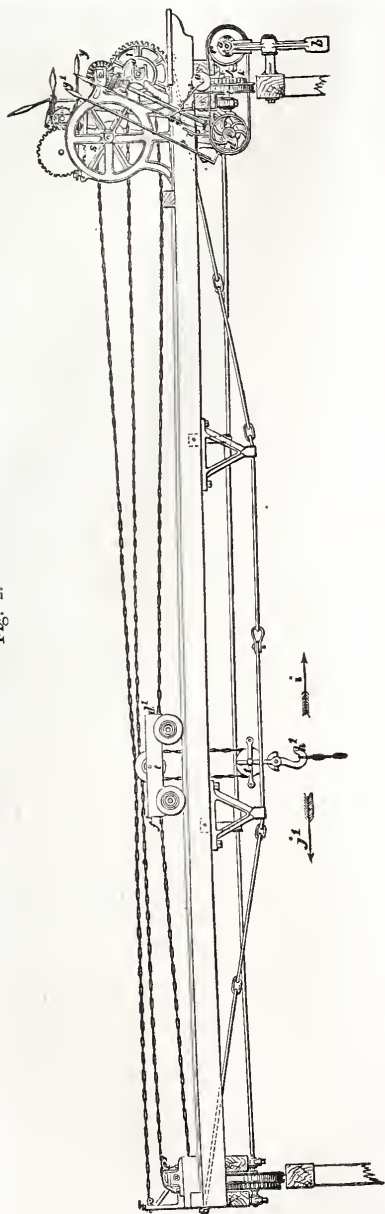
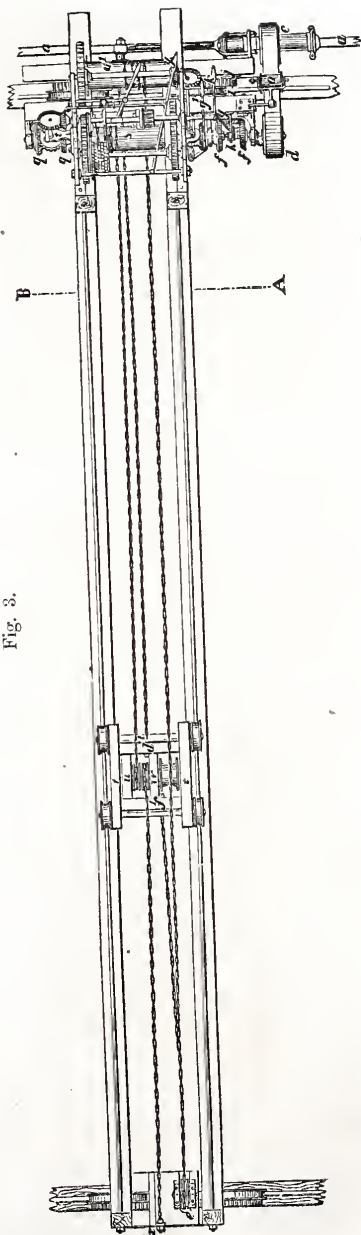


Fig. 3.



the beams being supported at intervals by uprights. A square shaft, *a*, fig. 1 and 3 ($2\frac{1}{2}$ inch diameter), runs the entire length of the tram road, and is attached to the longitudinal beams by movable supports, *b b b*. This shaft is connected at one extremity to the engine. Upon it, and revolving with it, is placed a drum, *c*, which works by means of a leather belt, the pulley, *d*, attached to the moving platform. The pulley, *d*, is fixed on the shaft, *e*, upon which are placed the bevel wheels, which impart the threefold motion to the crane. The bevel wheels, *f f*, which revolve freely on the shaft, are made so as to turn the bevel wheel, *g*, by means of the clutch box, *h*, which is attached to the shaft; so that by withdrawing the clutch box from one of the bevel wheels and putting it in gear with the other, the motion of the bevel wheel, *g*, is reversed, and when the clutch box is out of gear the bevel wheel, *g*, is stationary. The bevel wheel, *g*, is fastened upon the small shaft, *i*, to the other end of which is attached the pinion, *j*, which works the spur wheel fixed to the roller wheel, *k*, and imparts the longitudinal motion to the whole platform. As the platform would otherwise move away from the drum, *c*, which communicates the motion, it is made to slide freely upon the shaft, and being attached to the moving platform, by means of the rod, *l*, it always preserves its relative position with regard to the pulley, *d*. The difficulty of making the drum pass over the numerous brackets, that a long shaft must necessarily have to support it, is overcome by making the brackets swing on a centre, so that when the drum, *c*, protected by the guard, *n*, comes in contact with one of the brackets, *b b*, it yields, as shown in fig. 1, and allows the drum to pass over it. Immediately it has so passed, the weight of the lower extremity of the bracket causes it to resume its position, and the machine passes on to the next bracket, where the operation is repeated. In order to prevent the shock that would be felt in putting in motion so heavy a body as a travelling crane of 50 feet span, carrying, in addition to its own weight, a load of 3 or 4 tons, a friction roller, *o*, is made to press upon the leather belt that passes round the drum, *c*, and the pulley, *d*, so that before putting the machine in gear, the friction roller is raised;

the machine is then put in gear, and the friction roller gradually lowered. The momentary slipping of the belt round the pulley, *d*, when the weight of the friction roller is only partially resting upon it, causes the machine to move forward with an easy motion, and directly it is under way the friction roller is allowed to bear with the whole of its weight, and the crane then moves forward with its load, at its usual speed of 100 feet in 45 seconds.

The hoisting motion is obtained by communicating the power through the bevel wheels, *q q*, and the shaft, *r*, to the barrel, *s*, round which the chain revolves. In order to render the hoisting motion independent of the transverse motion, the hoisting chain passes from the barrel round which it is coiled to the truck, *t*, and after passing over the pulley, *u*, under the snatch block, *v*, and over the pulley, *w*, it is finally attached to the point, *x*, at the extreme end of the platform. To hoist a weight, therefore, it is merely necessary that the handle, *y*, which communicates with the clutch box, *z*, should be moved a few inches.

The transverse motion is imparted to the load by means of the barrel, *a*, which is worked from the shaft, *e*, by the bevel wheels, *b' b'*, and clutch box, *c'*, in the same manner as the longitudinal and the hoisting motions. Two chains are attached to the barrel, in such a way that one winds when the other unwinds. One of these chains is attached to the small truck, *t*, at *a'*, and the other is carried round the pulley, *e*, and fastened to the truck at *f'*, so that by alternately putting the clutch box, *c'*, in gear with one or other of the bevel wheels, *b' b'*, by means of the handle, *g'*, the truck, and with it the load, is moved backwards or forwards along the platform, at right angles with the motion of the platform itself.

Each of the above—the longitudinal, the transverse, and the hoisting motions, can be used independently of either of the others; or any two of the motions may be used in combination; or the whole three may be used simultaneously. For instance; at the same time that a weight attached to the hook, *h*, is being raised from the ground by the barrel, *s*, the truck, *t*, and consequently the load suspended on the chain, may be moved in the direction *i* or *j*, at the same time

that the whole platform may be moving in a longitudinal direction.

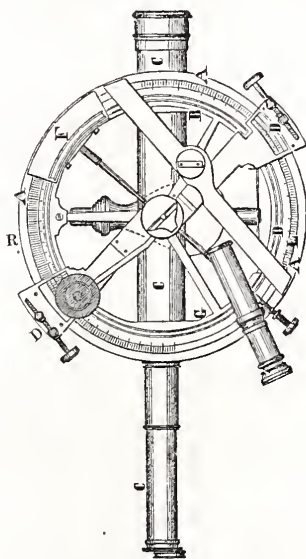
The numerous applications of which it is susceptible, such as to the goods traffic at railway stations, the unloading of vessels, and the general work in foundries, quarries, builders' yards, &c., lead us to imagine that before very long, travelling cranes worked by manual labor will become the exception, rather than as at present the rule. We ought not to omit to mention (for it is a very important point), that steam power can be readily applied on this plan to nearly all the existing cranes, and that therefore the cost of making the addition will be the only expense where they are already in use.

BEATSON'S PATENT INSTRUMENTS FOR
TAKING, MEASURING, AND COMPUTING
ANGLES.

The Universal Altimeter.

The accompanying figure is a side elevation of this instrument. A is a broad ring of brass, to one side or the back of which a telescope, C, is affixed in a horizontal line exactly coinciding with the centre of the ring. B, is a glass tube of about the sixteenth of an inch in the bore, which is let into a groove made in the front of the ring, and extends all round with the exception of about an inch or two, where a segmental air-tight junction piece, F, of metal, is inserted between the two ends of the tube, which are left open, and communicate freely with the piece F. The tube is about half filled with mercury (or other suitable fluid), which forms itself into a continuous thread of a crescent shape, with a fixed quantity of air between the two cusps. As long as the two fluids are left at liberty, they may of course be shifted round to any parts of the circle; but in the middle of the junction-piece, F, there is a valve, V (not seen in the figure), inserted, which is worked by a spindle and thumb-piece, from the opposite side of the instrument; and when this valve is closed, the motion of the fluid to either side of that valve is from that moment necessarily stopped. The eye-piece of the telescope is provided with darkened

glasses, to save the eye from the glare of the sun, and the field of view is divided in the centre by a wire, to show the line of collimation. On the front of the brass ring A, immediately outside of the groove containing the glass tube, and on opposite sides of the telescope, there are two quarter circle scales, R and L, engraved. Both of these scales have their zero points on the same line with the axial line of the telescope, but the numbers in R run upwards from 0 to 90, while those in L run downwards from 0 to 90; the 90° in the one case (R) representing the zenith and in the other the nadir. These scales are subdivided by two verniers, DD. The mode of using the



instrument is as follows: The observer first releases the alcoholic or other fluid in the tube B from the pressure of the columns of air at each end, by turning the thumb-piece from left to right; he then directs the telescope towards the sun or other object whose altitude it is desired to ascertain, and brings the cross-wire into contact (so to speak) therewith; which having done, he turns the thumb-piece the reverse way, which fixes the mercury at the exact level it had attained at the moment of contact, the column of

air in B pressing on the mercury at each end, and thus necessarily preventing the slightest displacement.

The observer next proceeds to read off the indications furnished by the two scales of the instrument; he sets first down the numbers on the left-hand scale, R, which come opposite to the top line of the fluid on the left-hand side, and then the numbers opposite the top line of the fluid on the right-hand side; which done, he adds the two sets of numbers together, and divides by 2, which gives the required altitude.

For example; if the

Left altitude be	46° 20'
Right altitude	47° 40'

The sum divided	2)94°
---------------------------	-------

Would give for the desired altitude	} 47°

The necessity for taking a mean of the two readings arises from the liability of the fluids to expansion, for were no change to take place in their thermometric condition after the contact, the numbers would remain necessarily alike on both sides.

The better to show to the eye the movements of the fluids in the tube, the bottom of the groove G may be stained of a red or some other bright color.

The "Universal Altimeter" may be contained in one framework with any of the ordinary sea and land surveying instruments; as is exemplified in the fig., where it is shown combined with a common sextant.

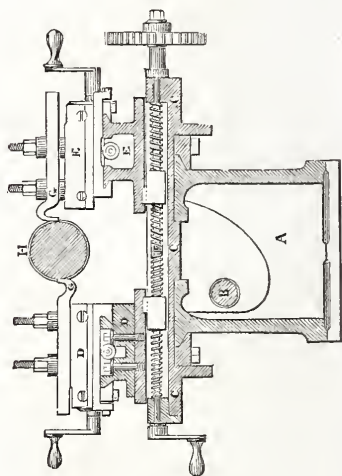


WHITWORTH'S PATENT DUPLEX LATHE.

From the Civil Engineer and Architect's Journal.

A paper was read before the British Association, at their meeting held in Edinburgh, August, 1850, by Mr. WHITWORTH, describing his new lathe. It is equally applicable for cylindrical or surface turning, or for cutting screws. The tools are shown as applied to cylindrical turning or screw cutting. For surface turning they would be placed at right angles to the position shown, and a self-acting motion given to the right and left

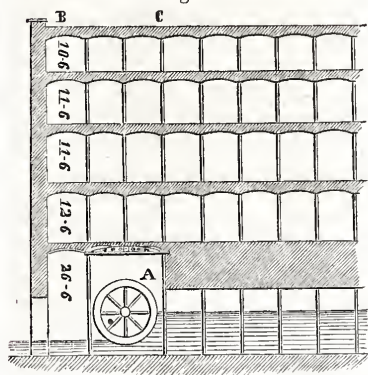
hand screw. The top slide-rests are both provided with compound slides, whereby each tool may be adjusted to the work independently; and when once adjusted, the right and left-hand screw only is used. Not only is double the work performed in the same time, but in long objects with a less expenditure of power, owing to the saving by the lessened pressure against the stay. The work done is of a superior kind, there being a perfect balance of forces, and consequently less vibration; and from the increased duration of the tools, only one-half the amount of error takes place. Messrs. Whitworth have five of these lathes in use in their establishment, and the work produced by them is of better quality and at half the cost it was formerly from the single lathe.



The annexed engraving is a transverse section of the lathe. A is the bed; B, the guide screw; C, the bottom slide-rest or carriage; D, a compound top slide-rest in front of the lathe; E, a second compound top slide-rest at the back of the lathe; F, a right and left-hand screw for moving the two top slide-rests simultaneously to or from the centre of the lathe; G G represent the two tools, namely, one in front and the other at the back of the lathe; H represents a shaft under the operation of cutting.

fig. 6, comprehending an area of about 1200 square feet.]

Fig. 7.



MR. HOPKINSON'S STATEMENT.—“We were employed by Mr. Cephas Howard to furnish drawings for the mill, and to superintend its erection; we constructed the water-wheel, as well as the shafting and gearing; we did not contract for the erection of any part of the mill; the mill was not built according to the original drawings, but in accordance with subsequent ones; the size of the mill was to be 140 feet long inside, supported by 14 regular 10 feet bays, the width 60 feet, in three compartments of 20 feet each. The mill was originally designed to be four stories in height; a portion was five stories, where there was a cellar for four bays at the west end. To superintend the erection of the works effectually, we had on the ground Mr. Daniel Glover, as clerk of the works; I had great confidence in him from previous knowledge, and from his conduct in this matter. In case any thing was wrong, the ultimate appeal was left to Wren and Bennett. This mill was intended to be turned in part by a water-wheel; there was a tunnel under the mill, 19 feet wide and 22 feet high; it was under the whole length of the mill, and from the first it was intended that the water-wheel should be fixed in this tunnel; the fixing of the water-wheel in this place would not, according to the original drawings, have interfered with the pillars. The fixing of the wheel rendered it necessary to dispense with one of the pillars; one entire range of pillars goes right through the old arch or tunnel down to the rock below; first of all they were wedged in the arch, and then connected by tie-bars with each other, and the adjoining walls; those pillars were cruciform in section; where the

water-wheel was intended to be one pillar could not be put, because it was under it; we designed a plan to dispense with the pillar; a large cast-iron flange-beam with a curved top was substituted; it was 3 feet $4\frac{1}{2}$ inches deep in the middle; the bottom flange was $20\frac{1}{2}$ inches wide, and of an average of $3\frac{1}{2}$ inches thick; the length of the beam was 20 feet from centre and centre; the depth of the beam at the end was $20\frac{1}{4}$ inches; the top flange was $9\frac{1}{2}$ inches broad, by 2 inches thick in the middle; the dimensions in the drawing of the beam produced are correct—(see figs. 1, 2, 3, 4.)—the ends of the large beam were circular, forming a gland; the beam was completely circular, went over the pillars, and went over collars on each column prepared to receive it; the diameter of the circle is $9\frac{1}{2}$ inches inside; we designed two columns to support this beam; they were cruciform in section, like the other long ones; they were 23 feet long to the underside of the beam; they were much longer than the other columns, as they had much more to carry, being $16\frac{1}{4}$ inches across the middle one way, and $18\frac{1}{2}$ across the middle the other way, and $2\frac{1}{4}$ inches thick in metal; they were 11 inches across the transverse bars; the collar which supported the beam was 18 inches in diameter; one entire line of column, four stories in height, rested upon the centre of the large beam, which also carried, in boxes prepared to receive them, the ends of the two of the ordinary fire-proof beams, forming part of the ground-floor, or the floor immediately over the cellar; these were bolted to each other through the large transverse beam, extended to walls on each side, and were intended to prevent the beam giving way sideways, as well as to support the floor; we consider that lateral stay was of great importance in maintaining the stability of the structure; we determined the form and weight of the beam upon calculations based upon experience; we should have avoided, if practicable, placing the entire weight of a row of columns on the middle of the beam; we consider that altogether the machinery, arches, and pillars, resting on the beam, would be equal to 62 tons; that is the load we believe was constantly on the middle of the beam; we also considered it might, some day, also be loaded with people, and that was the most considerable strain that could by possibility come upon it; that might increase the weight upon the centre for a time to 81 tons, supposing the two stories of the four were loaded with people standing as closely as they could be packed. From calculations based upon experience, I come to the

conclusion that the beam would break when a weight was upon it of 280 tons; I cannot give any idea as to the breaking weight of the two pillars, which supported the beam. They were fit to bear the greatest weight I ever calculated could come upon them. The cruciform form of pillars was adopted after mature deliberation, and for important practical reasons; it was not that we considered this form the strongest, or that it permitted the most economical distribution of the metal; I believe this is still the subject of debate amongst scientific men; our decision in favor of the cruciform shape was influenced by a consideration that, in castings of such extreme length, had they been circular columns of the same weight as these, there would have been the greatest danger and risk of having the metal unsound, or irregular in thickness on the sides, and at the same time there would have been no opportunity of practically testing whether they were really sound or not; but in the cruciform shape we could eye it all round. I produce a section (fig. 5) of one of the pillars which is broken; the diameter outside is $7\frac{1}{2}$ inches; one side is $2\frac{1}{2}$ inches in thickness, and the other seven-eighths of an inch; the pillar I refer to was one of the pillars in the bottom story; it must have been one of the three pillars of the bottom story; this pillar is broken in two; the fracture is slightly an oblique one; this defect could not be perceived outside the pillar; the cruciform shape of pillar allowed more room for the introduction of the water-wheel, and it afforded us considerable convenience in attaching the breast or sluices of the water-wheel; I believe this form of pillar has been used by architects of the greatest eminence; I believe they have been adopted in the new Houses of Parliament by Mr. Barry; the interior of the Manchester Athenæum rests upon four columns of the same description, and all the pillars in the Free Trade Hall are of the same description; we wished to obtain as much depth as possible in the middle for the beam over the water-wheel; the models for the beam and pillars were inspected by us before they were cast: the castings were made according to the models, as far as I know. The castings were furnished under contract with Mr. Howard; we were not parties to that contract, but I believe it was stipulated that the work should be done to our satisfaction; I inspected the models before the beam and pillars were cast; Glover would inspect the castings; we tested some of the ordinary beams; we broke one down at $28\frac{1}{2}$ tons dead weight, slung upon the middle; that would be about four times the load it would

have to bear; the large beam was not tested; the reason was that we had no means of slinging so heavy a weight as its own load; I believe means have been used in London, by hydraulic power, to test such beams, but it is not usual in this neighborhood; the large pillars were not tested; I saw the large beam on the ground before it was put up; it was the duty of the clerk of the works to see that all the castings were sound; after the large pillars were up, I inspected them minutely; I found them perfect to outward appearance; the large beams were put in in the beginning of September, I should fancy; I do not know when the erection of the arches and the flooring was commenced; the roof arches were turned in December, and that work was rapidly proceeded with; the arches of all the floors would be completed within three months, and the centres cleared away; I am not aware that any observation was made when the weight came upon the large beam as to whether it deflected or not; we looked along the beam and saw it looked straight; I saw it looked straight after the arching was complete; I went myself to the end and cast my eye along it; we considered there was so large a margin of strength that there was no doubt about its stability; at the time I looked along the beam it was not weighted with machinery. The foundation of the two pillars supported the beam in solid rock; there was no masonry, but the pillars were imbedded in an iron plate 3 feet square; the mill-gearing would not add to the weight on the beam, but the vibration of the mill might have an injurious effect upon the beam or any other part of the building; I do not think it had, but it might have; I considered the beam was so stayed and supported that vibration could have no effect upon it; after the first drawings, the site of the mill was changed; had the original design been carried out there would have been no need of a large beam. The site of the mill was shifted 11 feet nearer to the river; that caused the alteration in reference to the beam; the proprietors considered the alteration in reference to the site of the mill an improvement.

* * * * *

"There must have been a most tremendous strain upon the mill when the accident happened; the general stability of the mill was beyond all question; the common pillars were not tested beyond an external examination. The drawings produced show the fractures of the large beam; the beam is now nearly in the same position in which it was found. One of the pillars which supported the beam is broken off at the top and pushed aside; the other remains entire."

MR. FAIRBAIRN'S REPORT.—“Cast-iron may be said to be of almost universal application at the present time in the construction of buildings. Its use is at all events very extended, and the repeated occurrence of lamentable accidents, which have hurried numbers to their graves without the means of escape, or a single moment's reflection, evidences a deplorable want of knowledge of its general properties amongst those who undertake the designing and erection of buildings, and seems to call for the interference of the strong arm of the law, at least, for the supervision of some higher authority than now exists to enforce obedience to those well-established principles and facts, which point out a way to its perfectly secure adaptation when duly and accurately proportioned to the duties it may be called upon to perform. No material is of greater value in all the requirements of building, machinery, and the constructive arts generally; and when employed under the direction of men of knowledge and judgment, it fully establishes its claim to be reckoned amongst the most valuable mineral productions of the country. On the other hand, when its application is undertaken by, or intrusted to the management of, the unthinking and ill-informed, who possess no knowledge of, or have not taken the trouble to make themselves acquainted with its cohesive strength and powers of resistance, it becomes in such hands a most dangerous enemy, instead of a useful and powerful auxiliary.

“The following qualifications appear to me necessary to the successful pursuit of his profession by the practical architect and engineer: first, a knowledge of the strength and other properties of the materials which he employs; secondly, the skill necessary to distribute and proportion the parts in such form as will insure the maximum of strength with the minimum of material; and lastly, in the use of cast-iron and other metals, an acquaintance with the laws of expansion and contraction, in order that he might be enabled—in every construction which requires strength, and in the security of which the safety of the public is involved—to reckon with certainty upon the calculated or estimated duty of each particular casting.

“With these preliminary observations, and the more fully to ascertain the cause of the late accident, I would beg to direct the attention of the Jury to the scene of its occurrence, and to the state in which the building may be supposed to have existed previous to the fall. It will be observed that a water-wheel, about 20 feet wide, and 18

feet 6 inches diameter, was placed under the floor at the lower end of the mill, and that in order to carry those portions of the floors immediately above it, two columns in the form of a cross, A A, and the large beam B, were introduced as a substitute for the usual means of support, which, but for the water-wheel, would have gone down and rested upon the solid rock, the same as the other parts of the building. This could not, however, be accomplished; and we must now see what were the means adopted to meet the difficulty, and afterwards inquire what should have been the means necessary to give stability and security to the structure under the circumstances. Had the regular system of support followed in other parts of the mill been applicable in this particular spot, and had not the introduction of the large beam B been necessitated by the position of the water-wheel, the structure would, in all probability, have been standing in perfect security at the present moment. From this it follows that, according to my judgment, it must be admitted that the accident is attributed solely and entirely to the failing of this beam. The water-wheel was immediately under the column which rested upon the cross beam. This beam was again supported by the column A A, 23 feet long (in the plan produced), each running down, one in front and the other behind the water-wheel, to the bottom of the tail race. It may be questionable, in some minds, whether these columns, of such great length, were sufficiently strong; but on this point I have no doubts, although it must be admitted that they are not the strongest form of section, and that they would have been doubly secure if the same amount of material had been thrown into the form of cylinders.* The columns I, however, consider were sufficiently strong for the weight they had to support, and the causes of the failure cannot therefore be connected with them. With regard to the strength of the large beam, I, however, entertain a totally different opinion; and a comparison of the load it had to sustain with its powers of resistance will, I think, show that it must have been in a very precarious position from the commencement of the arching of the different floors till the very moment of rupture. To ascertain the exact ultimate powers of resistance of a beam of the form and construction adopted in the present case, is a question of considerable difficulty, owing to the large proportion of the body of the beam which had been cut out. I have always entertained a strong

* See Parliamentary Report in present number, discrediting this view of the value of cylindrical section to uprights bearing weight.—*Ed. Mech. Mag.*

dislike to beams or girders having the two resisting sides of tension and compression separated by openings of any kind, either in the shape of lattice-work, or any form of opening which has the tendency to injure these two important forces. I am a strong advocate for a solid connection of the upper and lower flanges of a beam, of whatever form it is made, or of whatever material, and think that a comparison cannot be admitted between what the solid beam would have carried (supposing the castings to be equally sound in either case), and the weight with which the open beam actually broke. On a careful comparison of these weights, I find that the beam, if it had been solid, would have required a load of 280 tons in the middle to insure fracture, whereas it gave way with the weight of the beams and arches, one row of columns and machinery, not exceeding 8 tons. The ratio, therefore, between the beam, if solid, and the beam open, is in this particular instance as the numbers 280 to 80, or 1 to 3½, the solid beam being more than treble the strength. Now it appears to me that so extraordinary a disparity as this cannot under any circumstances be reconcilable with the simple introduction of openings in the conducting or middle web of the beam, and I have, therefore, been induced to direct my attention to an endeavor to discover some additional cause of weakness, which would satisfactorily account for the remarkable falling off in the bearing powers of the beam. After a careful consideration and examination of the subject, it is my opinion that the same unfortunate decision which introduced the obvious defect observable in the construction of the girder with this open web, at the same time brought into operation another, and, perhaps, even more formidable element of destruction, in the opportunities which it afforded to the effects of unequal contraction in the cooling of the casting. This dangerous agency it is, at times, impossible to detect; and on this very account it is the more imperative that every form of casting should be avoided which is at all likely to call it into action. Its effects are too disastrous to be contemplated; for, in the present unfortunate instance, we find the paltry saving of half a ton of metal has reduced the strength of the beam from 280 to less than 100 tons. This is a subject of vast importance in the construction, forms, and sections of cast-iron beams, and I avail myself of this opportunity to make public the difficulties which I have myself repeatedly experienced in the casting of large beams. On the occasion of casting the beams which supported the hydraulic presses for raising the great tube

at Conway, the centre breaking weight of each beam was, by calculation, upwards of 700 tons; and as each of these beams was absolutely required to sustain a load of 375 tons, equally distributed, it became necessary to use every precaution, not only as respects the strength, but also as regards the quality of the castings, and the adoption of such a form as would insure uniformity in the rate of shrinkage which accompanies the process of cooling. To give increased support to the upper or lower flanges of the beam, it was suggested to introduce vertical ribs of the same thickness as the body of the beam, at distances of three feet along the surface on each side. The result of this alteration was, to use a familiar expression, the beam became "hide-bound;" unequal shrinkage took place, and out of four successive castings every one of them cracked along the edge of the vertical ribs. These experiments, and others which have been made since, convince me, that in every cast-iron beam, the top and bottom flanges, as well as the body, should be removed as much as possible from every thing in the shape of ribs, and to arrive at the practical section of greatest strength, it should be cast solid with smooth surface on all sides. In the large beam now under consideration, it appears that in addition to the opening, along the middle, two strong vertical ribs with a shelf to receive the two arch beams were introduced. Now, both of these have contributed to produce unequal contraction, and by that destructive process materially to injure the strength of the beam. If this be the case, it would be, in my opinion, unjust to attribute the whole cause of failure to the engineer having cut out considerable portions of the metal from the centre of the beam. A combined tendency to destruction has more probably been going on, viz., one from the influence of unequal contraction, and the other from the injudicious conduct of the architect, in having by such wide openings destroyed the important connection which should always be maintained between the top and bottom flanges. I have, therefore, no hesitation in stating that I have come to the conclusion, that the unfortunate accident at the Brinksway Mill has arisen from the weakness of the large beam which supported the columns and brick arches over the water-wheel. My opinion further is, that although the bearing powers of the beam had been very materially diminished by the openings made in it, yet it appears that it is in some measure owing to the unequal shrinkage of the casting during its cooling, occasioned by these very openings, that we must attribute failure.

IRON RAILROAD BRIDGES.

For Appleton's Mechanics' Magazine and Engineers' Journal.

SIR,—When the iron bridge on the New-York and Erie Railroad gave way, some time since, the president of that company, to quiet the public mind in reference to the supposed risk of traveling over that road, where it was known several of these bridges were built, came out in a card, and assured the public that the "objectionable" features of that road should be removed immediately—the bridges should be taken down.

Now I have no objection to the directors of public works doing with their own as in their wisdom they may see fit; but I do protest against their wholesale condemnation of that which they show themselves utterly ignorant of.

If the president or the engineer of the railroad company, in whom it is supposed the public repose some confidence, had frankly stated their undiminished confidence in the bridges still remaining, as differing essentially from the one which failed, and have given their reasons for this confidence, they would have done no more than the facts in their possession warranted, and at the same time have done justice to a worthy man, who has been made to suffer in his professional business by their want of judgment.

It is to be presumed, that before a president of a railroad company shall decide to throw away the funds of stockholders in rebuilding bridges which have *not* failed, he will get the professional opinion of some one known to the public, to the effect that it was at least probable they ultimately would have failed.

It may be supposed in this case (although it does not appear in the card), that the president *had* the benefit of professional advice; how valuable, the facts which follow will show.

Two different plans of iron bridges were built on the New-York and Erie Railroad; one well known as the "Rider bridge," (after the supposed inventor's name,) the other, from the modesty of its designer (S. Whipple, of Utica), but little known.

When the Rider bridge over the Delaware was building, engineers were opposed to the plan, or rather proportions of the bridge, and openly expressed their dis-

approbation.* When the bridges on Mr. Whipple's plan were being built at Binghamton, an estimate was made and submitted to the chief engineer of the railroad company, showing the great superiority of this plan over that of Rider's, and calculated to create misgivings as to the ability of the latter bridge to sustain the loads to which it was constantly subjected, as the proportions of its parts were such as to throw double the strain on a given point, where its capacity to resist, or the amount of material, was much less than in the Whipple bridge;† added to this, one of the Rider bridges built over the Buffalo creek had fallen, with a load less than 1,000 lbs. to the running foot, while the Whipple bridge was "warranted" to bear a rolling weight of 2,000 lbs. to the running foot.

I send you a plan exhibiting the proportions, and, as near as I can ascertain, the dimensions of the Rider bridge of 66 feet span, which gave way on the New-York and Erie Railroad last summer; and also send you a plan of the Whipple iron bridge, which did *not* give way under even greater loads, but which was condemned because of the failure of the first.

The Rider iron bridge, of which figure 1 is an elevation showing the general arrangement, figure 2 a plan, and figure 3 an isometrical view of the method of framing, is an extremely *rigid* combination of iron in the form of a truss, but is deficient in strength. The upper chord is of cast-iron, in two parts, bolted together, and "breaking joint," and forming a T section of about 12 square inches. The lower chord is of wrought-iron, composed of two plates, each 4 inches deep, by $\frac{1}{2}$ inch thick, placed side by side, with an interval of $\frac{3}{8}$ inch between them to receive the diagonal rods. These plates also "break joint," and at the joints have an additional plate of the same depth and thickness, and nearly two feet in length; the whole secured together by four bolts,

* See statement of J. E. Roebbling, Esq., Delaware and Hudson Railroad, R. R. Journal of 23rd September, 1850.

† See Report of Resident Engineer, at Binghamton, made to Chief Engineer N. Y. and E. R., July 1, 1848.

Fig. 1.

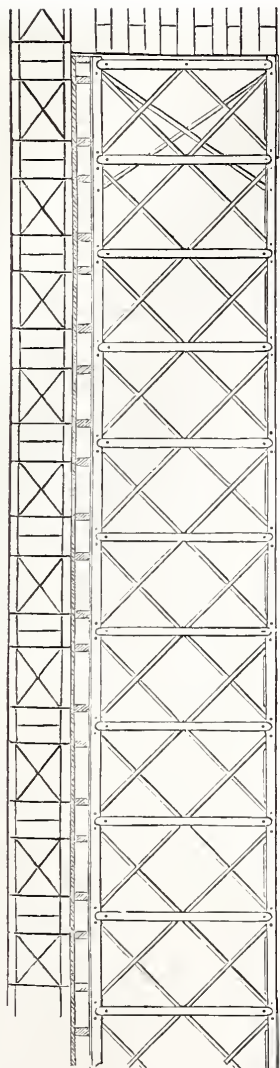
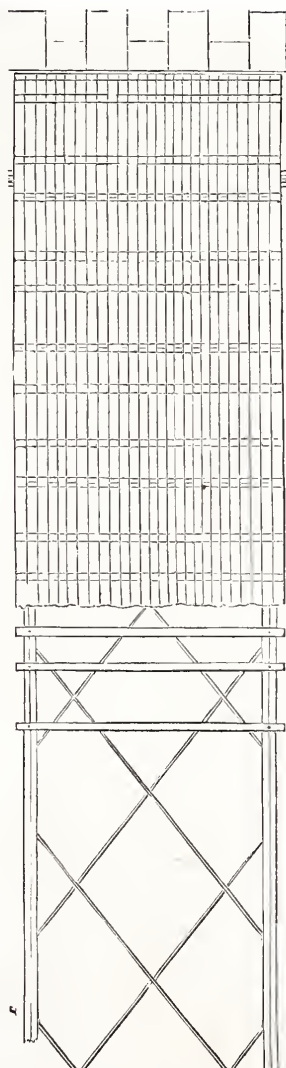


Fig. 2.



two on each side of the joints. The up-rights or posts connecting the chords, and to which they are bolted, are of cast-iron, about 3 feet 4 inches apart, of an H section, and of 8 square inches in area. Through a hole in the centre of these pass the diagonal rods, two in each pannel, of wrought iron, 2 by $\frac{5}{8}$ inches in the centre, and $2\frac{1}{4}$ by $5\frac{5}{8}$ inches at the ends; these

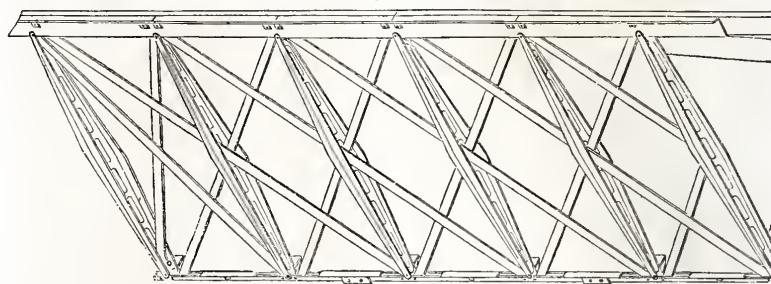
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are also bolted to the top and bottom chord.

The weight of each truss with its proportion of the load of the flooring is about $6\frac{1}{2}$ tons, or 14,500 lbs., which is equivalent in its strain on each truss to 7250 lbs. placed at the centre.

A train of locomotive engines may be estimated to weigh 2000 lbs. to the run-

Fig. 3.



ning foot (the load which broke the bridge was much less, but it was liable to be taxed to this amount), or on each truss 66,000 lbs., equivalent to a weight applied at the centre of 33,000 lbs.; which added to half the weight of truss, makes a total strain on the centre of each truss of 40,250 lbs.

The tension on the lower chord or tie is inversely as the height of the truss, in this case $7\frac{1}{2}$ feet; and the following equation represents it where W equals the weight on the centre of the truss,

$$T = \frac{1}{2} W \frac{33}{7.5} = 88,770 \text{ lbs., or } 22,192$$

lbs. tension per square inch of section of the lower chord or tie—and this upon the supposition that the whole section of the tie is available in resisting the strain, whereas the tie is diminished in its section, and thereby weakened in the same ratio by the bolt-holes for securing the diagonal rods; to what extent we are unable to determine precisely; but it may be supposed that a bolt-hole through the tie could not have been less than $\frac{1}{2}$ inch in diameter; this would reduce the bearing section of the tie to 3 inches, in which case the strain per square inch would have been over 29,000 lbs! The cohesive strength of wrought-iron being estimated at 60,000 lbs. per square inch.

It would appear at first sight, that the strains on the tie would be diminished by the action of the diagonal tie rods; and this to a certain extent might be the case; but when the bridge was loaded uniformly, those diagonal rods only could aid which extended from the tie on each side of the centre towards the abutments; and those meeting near the centre, having this direction, were bolted to the tie

several inches apart, of course were ineffectual in relieving this part of the tie of its tension.

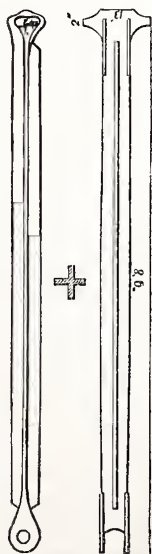
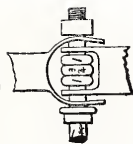
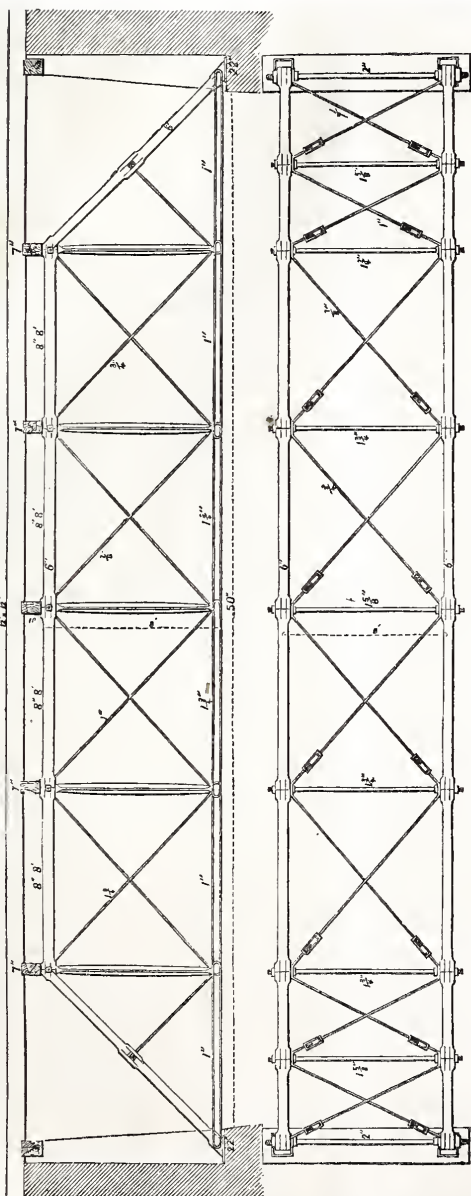
That some relief was afforded, however, is evident, from the fact that the bridge did not give way upon the first trial, as it would inevitably have done had the tie received the *whole strain*, which, as we have shown, was equal to the cohesive strength of wrought iron.

The dimensions of the tie, to insure safety, should have been such as to have taken the whole tension without yielding.

Again, it has been argued that the excessive heat of the season crippled the bridge, and this opinion has led to distrust of the material used, viz., iron. Admitting this to have been the fact, although unsupported by any evidence whatever, what would the action have been?

The extreme range of temperature in our climate would not have lengthened the tie one-half an inch, supposing it to have been put up at the freezing point. This would have been productive of no harm; but, the uprights being of cast-iron, which expands less than the wrought-iron diagonal rods, this difference of expansion would have been sufficient to have deprived the tie of the support obtained from the diagonals, and thus the whole strain was thrown on the tie, which, as we have seen, was wholly inadequate to its duty.

By reference to almost any work which treats of the strength of materials, it will be seen that it is considered unsafe to load iron or any other material to more than one-third of its breaking weight—one-fourth is a common practice, and a safer—but the Rider bridge



which fell, was liable to a strain *equal* to one half of the tensile strength of iron.

Let us now examine the Whipple bridge, which did not fall, of which fig. 4 represents the elevation, fig. 5 the

plan, and figs. 6, 7, and 8, the details of framing.

This bridge consists of two iron trusses of 50 feet span, and 9 feet high. What would be called the upper chord consists of cast-iron pipe, 6 inches in diameter, and $\frac{1}{2}$ inch thick, equal to 9 square inches—cast-iron uprights of + section, and 8 feet 4 inches apart from centre to centre, connect the upper chord on which the track rests, with the bottom or tie. This latter is of $1\frac{1}{2}$ round iron, in loops, two of which, side by side, constitute the tie between each pair of uprights. These loops pass over shoulders at the foot of the uprights, through which shoulders pass the diagonal $1\frac{1}{4}$ inch wrought-iron rods, secured and adjustable by nuts. The dimensions of all parts of this bridge are proportioned to the strains they are to receive, and were calculated to withstand a rolling weight of 2000 lbs. per running foot.

The weight of one truss with its proportion of track is less than 3 tons, or 6720 lbs., which is equivalent in its strain to 3360 lbs. placed on the centre of each truss, to which add the weight at the centre to a load of 2000 lbs. per foot run, viz., 25,000 lbs., and we have, as the weight on the centre of each truss, 28,360 lbs.

The equation expressing the tension on the tie, as in the first case, is $T =$

$$\frac{1}{2} W \frac{25}{9} = 39,388 \text{ lbs.}$$

The tie consisting of two links of $1\frac{1}{2}$ round iron or four rods of that size, gives as the section of the tie 4.9 square inches of wrought-iron; which makes the tension 8,039 lbs. per square inch, or a fraction over one seventh the strength of the material.

The lower chord or tie, as will be seen in the drawing, is independent in its fastenings of bolts or nuts, being a series of links from end to end.

A bridge in the neighborhood built upon the same principles, of 40 feet span, and weighing but 3 tons, was loaded with iron spikes in kegs, 1,500 lbs. per running foot; after remaining a day or two, the bridge had yielded nearly $\frac{1}{2}$ inch in the centre. A load of iron rails, equivalent to 1,318 lbs. per foot, was then rolled over on trucks without springs, thus subjecting the structure to a strain of more than 2,818 lbs. per foot, and the whole deflection

was $\frac{3}{4}$ of an inch. Upon removing the weight, the bridge returned to within $\frac{1}{4}$ inch of its original position.

Can any one suppose, that had these statements been verified to the public, they would have required as a measure of safety, the condemnation of *all* iron bridges?

W.

NEW-YORK, Dec. 10, 1850.

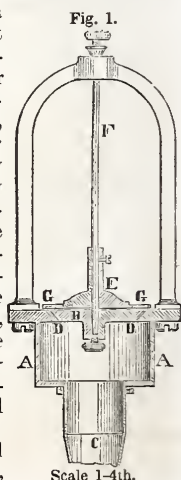
ON THE SIRENE—A NEW SOUND PRODUCER.

BY PROF. DONALDSON, EDINBURGH UNIVERSITY.

In regard to the vibratory movement of fluid masses, it has long been known that when solid bodies are brought into collision under the water, the liquid is agitated directly in all the points where it touches the solid vibrating bodies—acquiring thereby an undulatory movement, producing sound, heard of course at a greater or lesser distance, corresponding to the violence of the shock. It is also known that, by a direct shock, the normal vibrations of discs, and longitudinal vibrations of rods, throw water, mercury, and other liquids, into an undulatory or vibratory motion; and it has, therefore, been very generally supposed, that the shock of solid bodies is essential to the production of an undulatory or vibratory movement in fluid masses.

But the Baron de la Tour found that sounds could be produced under water without the percussion of fluid bodies, by throwing the water into rapid undulatory motion, by the play of the *sirene*, the instrument about to be described. The construction of this instrument, and the method employed, may perhaps be more easily understood by an examination of the annexed figures.

Fig. 1 is a vertical section of a *sirene*,



Scale 1-4th.

intended to act on the air. A, is a cylindrical brass box, about two inches in diameter, and one inch in height, and having a closed top, B, about a quarter of an inch thick, with a perfectly plane upper surface, highly polished. In the bottom of this box is an opening for the introduction of the tube, or "*porte vente*," C, by which wind is forced by bellows into the box. Openings, D, are pierced angularly through the top, B, as also represented in the plan of the top and revolving disc, in fig. 2, and in the side elevation of the same parts, fig. 3. These holes—16 in number—are disposed in a ring, and are equidistant from each other. They are each of the same size, and the spaces between them are slightly larger than the holes themselves, in order that when the revolving disc, E, is in motion, its corresponding ring of holes, G, may be quite cut off from any communication with the box, A.

The revolving disc, E, has a long boss upon its upper side for adjustment upon the vertical spindle, F, which has adjustable screw-centres at the top, in the upper part of the guide-frame, and at the bottom, in the box, A. The holes, G, in this disc, correspond in every respect with those in the top of the box, A, with the exception that they are pierced at an opposite angle, in order that the pressure of the upward currents or jets from the box beneath may cause the disc to revolve; the angularity of these holes is in relation to the *circumference* of the disc. The two surfaces of the disc and top of the box are highly polished, and are so adjusted as to cause no perceptible friction, and yet to work close enough to prevent the escape of any air from between them. This is a very difficult matter to accomplish in practice, and the beauty and accuracy of the surfaces produced by the French makers of these instruments, is very remarkable.

It is then easily seen how, when air is forced into the box, A, the jets issuing from the holes, D, impinging on the oblique surfaces of the corresponding holes

in the disc, E, cause it to revolve at a rate proportioned to the pressure.

Now, let it be supposed that one hole only was pierced in the box, and one in the disc, the air, in its passage through the holes, would force round the disc, and during its revolution the wind *within* the box would be prevented from passing to the air *without* the box, until the hole in the disc came round to the hole in the box, when the wind would rush through as before, and thus keep up a regular rotatory motion, causing a stroke or pulsation on the atmosphere at each revolution. When these pulsations are perfectly regular, and attain to a rapidity of thirty-two in a second, a musical note will be obtained appreciable to most ears, although a very grave note. As the pulsations become more rapid, the note becomes more acute. The greater the number of holes the more rapid the pulsations.

This explanation will render it unnecessary for me to enter into further details, except to describe the plan I have adopting in using the *sirene* under water. A, is a large square cistern, the sides of which are of strong plate glass, and the bottom of mahogany, in a very strong frame. The *sirene*, B, made as already described, is firmly fastened down in the bottom of the cistern, a piece of caoutchouc being interposed between the sur-

Fig. 2.

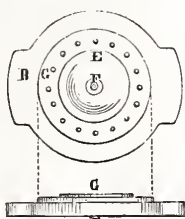
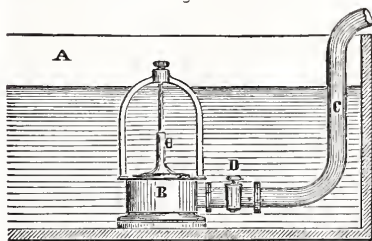


Fig. 3.

Fig. 4.



1-Sth.

faces, to prevent the movement of the *sirene* from acting on the bottom of the cistern. The actuating water is brought by the gutta percha tube, C, from a reservoir elevated about 30 feet above the cistern. The details of the instrument are analogous to those of the air *sirene*, except that the water is brought into the box, B, by a side branch, governed by a stop-cock, D, and the holes in the box

and disc are rather larger and fewer of them. On turning the cock, D, the water in the reservoir rushes into the cylindrical box, forces its way through the holes pierced in the upper part of the box at E E, which strikes those pierced in the disc, and thus keeps up a rotatory motion.

It must be observed, however, that unless the cistern is filled so as to completely cover the sirene, the water which is forced through the revolving disc will strike the *air*; for although it is a jet of water that is cut off by the rotation of the disc till the hole in the disc comes round towards the hole in the box, yet nevertheless it is the *atmosphere* which receives the shock or pulsation. But if the water completely covers the sirene, so as to be an inch or more above the revolving disc, then it is the water in the cistern which receives the shock or pulsation. The pressure of the water flowing from the reservoir causes the disc to revolve under water, and the small streams of water which are forced through the holes pierced in the box are cut off in their transit by the movement of the disc, until the holes in the disc corresponded to those in the box, when the water again rushes through and is again stopped, thus keeping a continuance of regular alternations. The slight shocks or pulsations thus created in the water produce musical tones of singular purity, which become even purer and more and more sustained as the water flows into the cistern. It is also remarkable, that the gravest tones thus produced under water are far more readily appreciated, that is, recognised as musical, than tones produced by a similar number of vibration in the atmosphere.—*Glasgow Mechanics' Journal*.

THE "HYDRO-CARBON," OR RESIN AND WATER GAS.

The method of obtaining hydrogen gas from water, by passing steam through or over red-hot iron, has been long known. The steam, in contact with the hot iron, is decomposed, the oxygen uniting with the hot iron to form an oxide of iron, and the hydrogen is freed. But the flame of hydrogen alone, although emitting great heat—and we believe to such an extent

as to be available for cooking—is still nearly worthless as a source of illumination, being barely visible. In order to fit it for the latter purpose, it must be carburetted, and the more carbon it contains the higher its illuminating power.

The camphine lamps owe their brilliancy to the larger proportion of carbon contained in the turpentine, the imperfect combustion of which causes the dense smoke and soot which render its use disagreeable.

The carburetted hydrogen obtained from water and resin, would undoubtedly possess an advantage over that from coal, viz., its freedom from sulphur and some other impurities; but the cost of fuel for heating the retorts, the action of the oxygen on the retorts themselves, and the cost of the resin, would, in our opinion, render its cost greater than that of coal gas, admitting that the production of the gas from these two substances was in all cases entirely successful, of which we are not as yet satisfied.

Two or three years since, this water gas was exhibited in London, and the method of generating it was almost identical with that exhibiting in this city.*

* GAS FROM WATER.—This great desideratum has been found at last, though the means by which the gas is obtained from the water is more expensive than the method which Professor Payne was supposed to have discovered. The proprietors of the Astor House have been using this gas for the last two months. The light, they inform us, is much superior to that obtained from the common gas, with which the whole city is supplied, while the expense is less than one-half. The apparatus, which is set up in a small building at the rear of the hotel, is very simple in its construction, requiring only the attendance of two men, who, in seven hours, can turn off sufficient for twenty-fours' consumption. The following is, as near as we could ascertain, the process by which the gas is produced:

The water used in its manufacture is discharged from a can in limited quantities, into a pipe passing through the retort. This retort is kept constantly supplied with iron and charcoal, the intense heat from which converts the water, in its passage through the pipe, into steam. The steam thus formed is amalgamated with liquid resin, of which there is always a large supply kept in a boiler placed immediately over the retort, so that the gas is obtained simply from the combination of steam generated in the manner described, and the liquid resin. The volatile oil produced during the manufacturing process, is discharged through a separate pipe into re-

The apparatus employed consisted of a furnace, in which were placed three upright iron retorts; two of these were nearly filled with coke, and old pieces of iron. Water was admitted in small quantities into one of these, and being converted into steam, was decomposed by the iron, and the hydrogen gas resulting, absorbed carbon from the red-hot coke. The gas and steam passing thence into the second retort, was still further decomposed, and received an additional dose of carbon before passing into the third retort, where it was brought into contact with heated tar, and thus was more completely carburetted before being forced through vertical tubes to deposit the superfluous tar preparatory to entering the gasometer ready for use, the ordinary purification by lime being rendered unnecessary.

The objection to this gas was, we believe, its expense. At all events, the experiments were never put in practice on a large scale; and, if Professor Fyfe is to be credited, never will.

From a Paper by Dr. A. Fyfe, Professor of Chemistry, King's College, Aberdeen, in the *Journal of Gas Lighting*, No. 6, for 10th July, 1850.

"It is well known that when water is passed over iron at a red heat, excluded from air, it is decomposed; oxide of iron is formed, and hydrogen gas is evolved, the purity of which depends on the kind of iron employed. Were the iron clean and pure, then pure hydrogen would be the result; but this very seldom occurs in practice, because, not only does the iron contain foreign ingredients, but it is soiled also by the hands and tools of the workmen in the factory from which it is procured, in the state of filings or turnings. Hence it is that the specific

gravity of the gas which it yields is considerably beyond that of pure hydrogen, and the appearance of the flame is different. The light afforded is extremely faint.

"When water is passed over carbon, either as coke or charcoal, at a red heat, and excluded from air, decomposition ensues, and a gaseous fluid escapes, with regard to the nature of which different opinions have existed. It was at one time supposed to be, and indeed in works on chemistry it has been described as, a mixture of a variety of gases, the principal of which is light hydro-carbon, better known as *marsh gas*, *coal-mine gas*, and *fire-damp*. More recently-performed experiments, however, have proved that it does not contain hydro-carbon, or at most but a trifling quantity of it. In a paper published by me in the 'Edinburgh Philosophical Journal,' July, 1837, it is shown that the gas produced by this process is a mixture of hydrogen, carbonic oxide, and carbonic acid, the proportions varying according to the heat and other circumstances. In these trials I found that the carbonic acid was about 18 per cent. After removing it, the remainder was of specific gravity 470, and consisted of a mixture of hydrogen and carbonic oxide, in about equal proportions. By combustion it yielded carbonic acid and water, the light afforded being extremely feeble. As the gas, after the removal of the carbonic acid, was of specific gravity 470, it must have been, before its removal, of specific gravity about 660.

"Allowing the correctness of the results now stated, it is evident, that when water is brought into contact with iron and carbon at a red heat, in the same vessel, the gas evolved will be either hydrogen alone, provided the whole of the oxygen unites with the iron; or it will be a mixture of hydrogen, carbonic oxide, and carbonic acid; the proportions varying according to the surface of carbon and iron exposed, and to the facility with which the vapor of the water is brought into contact with the one or the other. Of course, the specific gravity will also vary according to circumstances. I have already said that both carbonic oxide and hydrogen burn with a very feeble flame and give very little light. The appearance of the flame of the mixed gases will, of course, vary according to the proportions.

"The following experiment was made, with the view of ascertaining the illuminating power of the gas prepared from water by the process recommended by Mr. White, though not exactly with the same arrangement. The retort used was stuffed with charcoal and scrap iron, which were brought to the proper temperature after the door of the

ceiving vessels. This oil is disposed of at half a dollar per barrel. The expense of the charcoal and iron consumed is very slight, and the amount of resin required is about a barrel and a half.

The apparatus was put up by the Union Gas Light Company, which has its head-quarters in Jersey City. The stock of this company has been taken up and the present capital is about \$500,000. The whole of Jersey City, it appears, is to be lighted up with this gas, and the company has already entered into contracts for lighting several hotels in the different cities of the Union.—*Railroad Journal*.

retort was secured. Water was then allowed to flow in, the supply being regulated by a stopcock. The gas given off was measured in the usual way. From $7\frac{1}{2}$ lbs. of water $59\frac{1}{2}$ cubic feet of gas were evolved, the specific gravity of which was 574. By lime-water the condensation amounted to 16.5 per cent., indicating, therefore, that quantity of carbonic acid; that is, about one-sixth of its volume. Had the specific gravity been taken after abstracting the carbonic acid, it would have been found to be very nearly the same as that formerly mentioned, that is, between 470 and 500. The gas burned with a very feeble bluish flame, yielding carbonic acid and water. With a flame 5 inches long from a jet with an aperture of 1-33d of an inch, the consumption was 1 foot in 32 min. 30 sec.; that is, 1.84 foot per hour.

"The next set of experiments was made on resin, with the view of ascertaining the quantity and quality of the gas which it affords, by decomposition at different degrees of heat. The resin was melted cautiously, and poured into the reservoir connected with the retort, previously brought to the same heat as that requisite for the manufacture of coal gas. By a proper contrivance it was kept warm and sufficiently fluid to enable it to flow easily. 6 lbs. 2 oz. yielded 61 feet of gas; that is, very nearly 10 feet from the pound. The gas was of specific gravity 640. Lime-water indicated 10 per cent. of carbonic acid. With a jet 1-33d of an inch in diameter, and a 5-inch flame, the durability was 50 min.; that is, 1.2 feet per hour. By the photometer the jet gave the light of 2.2 candles per foot. The Argand with 56 holes, consuming 5 feet per hour, gave the light of 2.45 candles per foot.

"This gas being of specific gravity 640, a cubic foot would weigh 343 grs. The gas, therefore, in all, weighed nearly 3 lbs.; consequently upwards of one-half of the resin employed was wasted by the deposit of carbon in the retort, and by the distillation of volatile oil.

* * * * *

"I come now to consider the quality of the water-resin gas, or, as it is very improperly called, the hydro-carbon gas, and its value for the purposes of illumination. This gas is generated by the decomposition of water and of resin in separate retorts; the former being decomposed by heat, the latter by heat with the aid of carbon and of iron. The gas thus produced is merely a mixture of resin gas—that is, of a gas resembling coal gas in its composition—and of hydrogen, with variable proportions of carbonic oxide and carbonic acid, according as the

water is decomposed. I regret that I cannot give the results of the manufacture of the gas by the apparatus erected under the superintendence of Mr. White, as I fully expected to have been able to. In the different attempts which I made to ascertain the quality of the gas manufactured by that apparatus, several circumstances occurred to prevent me from arriving at the truth. In the first trial I found the gas of high illuminating power, *but it was afterwards ascertained that tallow was mixed with the resin*; in what proportion I did not hear. At my next visit the gas was made by using both retorts, employing resin for the one, and water for the other; but it was afterwards discovered *that the water retort was not in action*, consequently the gas collected was entirely that from the decomposed resin, or a mixture of resin and tallow.

I do not, however, consider this of great consequence. I have ascertained the quality of resin gas, of gas from mixture of resin and tallow, and of water gas, *separately*, and as these, by Mr. White's process, are generated in separate retorts, we must consider the gas thrown into the gasometer to be merely a mixture of those mentioned in variable proportions, according to the proportions of the articles employed in their manufacture, and the rapidity with which the one and the other is decomposed. We can thus arrive at the quality of the hydro-carbon gas, as it is called, and its consequent expense for the purposes of illumination, as compared with other sources of light; as, for instance, with coal gas.

"As resin is composed of C. 10, H. 7, O. 1, the utmost that it can yield of olifiant is 49; of light hydro-carbon, about 28 from 75 of resin; that is, about 64 per cent. of the former, and about 37 per cent. of the latter. But resin never yields olifiant only; independent of carbonic acid and oxide, the gas is a mixture of olifiant and of light hydro-carbon, with perhaps a slight admixture of uncombined hydrogen. The gas, when it contains about 6 per cent. of carbonic acid, varies in specific gravity from about 570 to 660. I have never found the condensation by chlorine to exceed 8 per cent., thus making the composition to correspond with the specific gravity; for a gas composed of 8 of olifiant and 92 of light hydro-carbon, would be of specific gravity a little above 600. I have no doubt that resin gas, when free from carbonic acid, will be found to be of about that specific gravity. I have stated the specific gravity of the water gas, as generated, by Mr. White's process, to be about 574. Supposing that it is mixed with an equal volume of resin gas,

then the specific gravity ought to be about 580, or somewhere between that and 600; that is, presuming the absence of carbonic acid. Supposing the per centage of carbonic acid to be about 6, then the specific gravity would be about 630.

"I must confess that I am at a loss how to reconcile this with the very remarkable statement made by Mr. White, that the gas manufactured from *resin and water* is of specific gravity 924, and contains $12\frac{1}{2}$ per cent. of olifiant. A gas having $12\frac{1}{2}$ per cent. of olifiant, the remainder being water gas or light hydro-carbon, would not exceed 650 in specific gravity. His gas, therefore, must either have contained much more olifiant—indeed, have been composed almost entirely of olifiant—or must have had a very large admixture of carbonic acid or carbonic oxide. Resin gas did not in my trials exhibit beyond 8 per cent. of olifiant. The high specific gravity of this gas must, therefore, have been occasioned by carbonic acid or carbonic oxide, perhaps by both; the latter of which is valueless for the purpose of illumination, and the former detrimental.

"With regard to the illuminating power, I have never been able to manufacture gas from *resin alone* with more than 8 per cent. of olifiant. Mr. White states that, by his improved process, he gets the gas from *resin and water* with $12\frac{1}{2}$ per cent. of olifiant. How is it possible that, by the addition of resin gas to another gas of lower specific gravity and illuminating power, he gets a gas of higher illuminating power and greater gravity? To me it is a puzzle.

That there is a large admixture of carbonic acid in Mr. White's gas, when he takes the specific gravity, appears certain. He says that now there is but little carbonaceous deposit in the retort, owing to the peculiar mode of arrangement and admission of the hydrogen and carbonic oxide. Now, as by the manner of decomposing the water, oxide of iron is formed in the retort, it is evident that the whole of the oxygen of the water is not converted to carbonic oxide by its union with carbon; the specific gravity of the gas, therefore, which is evolved from the water, ought to be below 522, which is that of a mixture of equal volumes of carbonic oxide and hydrogen; but, suppose that it was not much below that, and that no carbonic acid is present, then to get from resin and water a gas of specific gravity 924, containing olifiant, with the residue composed of equal volumes of hydrogen and carbonic oxide, which it should be were all the oxygen disengaged as carbonic oxide, there ought to be about 87 per cent. of olifiant. Supposing that Mr. White's

gas was a mixture of olifiant, carbonic acid, and water gas, which contains equal volumes of carbonic oxide and hydrogen, that the water gas is about 522 specific gravity, and that the olifiant gas was $12\frac{1}{2}$ per cent., then, to have it of the specific gravity 924, it should be about 12.5 olifiant, 52 water gas, and 35 carbonic acid. Were the carbonic acid removed from this gas, the specific gravity would then be a little above 600, most probably the real specific gravity of the *inflammable* gas obtained from resin and water together.

"With regard to the illuminating power of the water-resin gas, Mr. White has stated that 'it is 26.5 per cent. superior to Manchester cannel gas, and 20.5 per cent. to the Salford cannel gas.'

"By the chlorine test, independent of durability, the illuminating power of Mr. White's gas, containing 12.5 of olifiant, ought to be 64 per cent., instead of 26.5 and 20.5, beyond that of the coal gases he mentions. Of course, if we take durability also into account, the value should be greatly beyond that.

"The specific gravity of the Manchester gas at the time I tried it was 451. The durabilities, with the same burner, are as the square roots of the specific gravities. Taking durability into account also, the illuminating power of Mr. White's gas ought to be at least 90 per cent. greater than that of the Manchester gas.

"It is evident from this, either that Mr. White's gas must be one *sui generis*, or that there is some strange inaccuracy in the mode of ascertaining the quantity, and of testing its qualities. Can it be that the quantity of gas evolved, say 10,000 feet, of specific gravity 924, from 6 cwt. of resin and 24 gallons of water, and which I have said is a mixture of olifiant, light hydro-carbon, carbonic acid, and carbonic oxide, with perhaps a little hydrogen, was the quantity indicated by the meter, immediately after the gas escaped from the retort, and was then of the specific gravity stated, and that, after it had stood over water in the gasholder for some time, and by which it would lose its carbonic acid, it *then* contained 12.5 of olifiant? If so, the quantity of gas valuable for the purpose of illumination must, by the abstraction of carbonic acid, be far below what Mr. White states. Be that as it may, till Mr. White describes more minutely than he has done, his method for finding the quantity and quality of his gas, I must adhere to the conclusions which the trials I have now recorded warrant, viz., that the quantity and quality of gas, after being properly purified, will be found to be

far inferior to what Mr. White has stated; that in all probability the quantity of gas from *resin* will in practice not exceed 8 or 9 feet per pound, that is, about 1000 feet per cwt.; that the gas after being purified will be of specific gravity not much beyond 600; the condensation by chlorine not beyond 8 or 9 per cent.; a foot of it not giving more than the light of from $2\frac{1}{2}$ to 3 candles. If so, then, when that gas is mixed with about its own volume of water gas, no doubt the quantity will be increased, but to the *serious deterioration of the illuminating power*. That of the water may be said to be *nil*, or a very near approach to it; consequently the reduction in the illuminating power of the other will be just in proportion to the addition; indeed, were it not that the water gas adds to the quantity, and perhaps, from the peculiar mode of generating it, also adds to the specific gravity, of which, as an indication of the value, some have a high opinion, I strongly suspect that Mr. White had better dispense with it altogether, and thus save the trouble and expense of manufacturing, and of storing and transmitting to the public, an article which, for the purpose of illumination, is, as now generated, absolutely useless."



ENGLISH AND AMERICAN STEAM-SHIP
BUILDING—OCEAN NAVIGATION—THE
CUNARD AND COLLINS'S LINES.

From a communication to the Editor of the London
Mechanics' Magazine.

The subject of my remarks, and to which I earnestly desire to draw the attention of your readers, of the public, and particularly of English engineers, is the merits and demerits of the two systems of engineering adopted in the vessels of the Cunard line, which have been built and manufactured in this country; and in those of Collins's line, the production of our brethren in the United States. Both are excellent in their way, and each, in the absence of the other, would have been—indeed has been—considered perfection; but competition, and a very proper and laudable rivalry, has shown which of them it is best and most desirable to adopt in extending Atlantic steam navigation.

They have shown this to a certain extent, but no more. Neither of these lines of steamers (as it respects their machinery) have developed the highest state of engineering knowledge now

and for some time past existing in this country. Humiliating as it may be to British engineers to acknowledge that they are beaten, although by their next of kin, it is tolerably certain that we shall have to make that admission; and your intelligent correspondent in No. 1398, prophecies this: to the best of my belief this will be so, has been so, and it is capable of very easy proof why it should be so.

But, that it could not have been otherwise, I utterly deny. I assert, that means are known to us by which both these systems (and they differ but in small degree), may be immeasurably excelled, at a much cheaper outlay, diminished cost for repairs, both in engines and ships, and a far more efficient result in all respects; and that this is not only practicable, but has really become an acknowledged fact, it shall be my object to establish.

Steam engines are of various constructions and mechanical arrangements;—in *principle*, they are as left to us by the immortal Watt. Modern necessities and ingenuity have introduced many deviations from his plans, and, as might be expected from extended practice and experience, with good result. Mr. Watt left us the "beam" or "side-lever" engine—excellent in its way, and suitable to his time (it has many votaries even now); others have introduced the "direct engine;" others, tubular boilers in place of *flue* boilers; others, feathering or eccentric paddle-wheels, in lieu of the common radial wheel.

Cunard's vessels possess none of these improvements;—they have beam engines, flue boilers, and radial paddle-wheels.

Collins's vessels have beam engines and radial paddle-wheels; but the boilers are partly tubular, and *alone are the cause of their superiority over their competitors*. This has been so ably shown by your correspondent already quoted, in No. 1398, page 402, that I do not think it either necessary or just to occupy your space with further proof than to observe, that the great evaporative power of the boilers, and the extended grate surface (a capacity to consume fuel with economy), must be conclusive to the minds of all professional men, and that all other things being the same,

we must succumb. We must "go ahead" again by merely availing ourselves of the means we possess, and we assuredly shall be triumphant in a superlative degree.

This is matter of grave import for the consideration of those whose pecuniary interests are connected with the Cunard line of steamers; it is still more of importance to another great and flourishing company, of whom I shall speak hereafter, but whose infatuation and error is so utterly unaccountable, when we reflect that they ought to be—must be—fully aware of the great advantages they might have secured by a more able and discriminating course, which, if taken, would have been the means of placing them at the head of the steam navigation of the world. It will be their ill-fortune to see the great mistake they have made in the spring of 1850.

It must be evident to all men, that small space occupied by steam machinery on board ship, and its minimum weight, compatible with strength and efficiency, must be that which is to be desired. All modern improvement has tended to this end; indeed, diminished weight of machinery is really *power*, for thereby you decrease the *immersion* of your ship, lessen her resistance, and increase her velocity, with a greater capability to carry her cargo and make a voyage remunerative without additional outlay in fuel.

To do this to the greatest extent, there can be no doubt that we must adopt *oscillating or vibrating steam engines, tubular* or other improved boilers, and eccentric paddle-wheels.

I have already remarked that Cunard's vessels are fitted with the ordinary main lever engines, common flue boilers, and radial paddle-wheels; the workmanship of the whole is excellent—in fact, it is a splendid piece of mechanism, and, of its kind, perfect. It has also been noticed that Collins's vessels differ only in the construction of the boilers, which are partly tubular; and this, though but a small instalment of our knowledge, is still sufficient to establish a superiority, and therefore powerfully supports the position I have taken, and shall now proceed to make evident and patent to your readers.

The subject may be divided into the three portions already stated; namely, engines, boilers, and paddle-wheels, and these I will take *seriatim*.

I. *Beam engines* are the most ponderous of all constructions now extant. I have before me a list of about 150 pairs of these machines, which, with common flue boilers and water radial paddle-wheels, and coal boxes, average about 23 cwt. per nominal horse power. The weights may be taken as follows, in decimal parts of a ton, and may be useful to many of your readers:

Engines alone	=515
Paddle-wheels	=092
Boiler and apparatus . . .	=310
Water in ditto	=207
Coal bunkers	=031=1.55,

or just 23 cwt. per nominal horse power. I believe this to be an average weight of beam engines, &c., as detailed; but, if report be true, the machinery of the Cunard steamers weighs even still more; it is said to be 1000 tons! which, for 800 horses power, is just 25 cwt. per nominal horse!

The superiority of Collins's vessels does not arise from *lighter* machinery, but from the greatly enlarged evaporative power of the boilers, without increase either in weight or space.

Beam engines are very expensive to manufacture. Oscillating engines, at 40*l*. per horse (boilers and paddle-wheels being the same), is a more lucrative order than beam engines at 50*l*. per horse, which will appear evident when we compare the quantity of *material* in the two kinds of engines;—they are more expensive in repairs, use more oil and tallow from the number of the parts, are subject to transverse strains, requiring an enormously strong and heavy bed-plate to counteract the pressure upon the main gudgeon, which has to resist *double* the force of the steam upon the piston.

It is also dangerous to work beam engines under heavy pressures of steam, unless the motive parts are made more than usually heavy and strong—generally $2\frac{1}{2}$ times the nominal power is the usual practice. I know one or two instances where three times has been obtained, but accidents have resulted, to which they will always be liable; but make the connections as strong and heavy as you please, these engines can never contend in this respect with the direct or the oscillating engine.

The space occupied in the ship is also of paramount importance. Beam engines

of 800 horses power will require not less than 35 to 36 feet in the most important part of the vessel. Oscillating engines of the same *nominal* horses power will have ample room in 14 or 15 feet, and they require less than one-half the timber foundation or “sleepers” to erect them upon.

The oscillating engine is self-contained; all its strains are direct—not doubled (as in the main gudgeons of beam engines); a great number of parts are banished, and simplicity in its integrity duly obtained: the centre of gravity of the whole is lower, and therefore tending to increase the stability of the ship; the wear and tear is less, and when requiring repair, the cost is small from the few working parts. It may be made to bear almost any pressure by a slight increase in the crank shafts and piston rods. It goes at once to its work, which it does with vigor and certitude—indicator diagrams fully proving a proper effect for every atom of steam that is used.

And, lastly, the *weight* of the oscillating engine is just *one-half* that of the beam engine. A *pair* of oscillating engines, properly constructed (for we have quacks in engineering as well as in medicine), will weigh no more than *one* beam engine.

Taking an average of upwards of 3000 horses power which I have designed, the engines alone weigh just .253 of a ton per *nominal* horse, or say 5 cwt. only.

Here, then, is a great secret, not so fully known as it should be; and I shall be amply rewarded if I succeed in convincing those of its truth who are so deeply and pecuniarily interested in this question.

It may be as well to insert here the weight of oscillating engines, tubular boilers, and mechanical wheels, which are as follows:

Oscillating engines	=253
Patent paddle-wheels	=110
Tubular boilers, having sixteen square feet of absorbent surface per horse power and apparatus	=215
Water in the boilers	=100
Coal-boxes	=030
	708

or just 14 cwt. per nominal horse! and this is not supposition, but what the writer has done with 3000 horses power, and what has been done by Penn for several years past in some of the finest of our men-of-war. The *Retribution* may be quoted, as one instance of the advantages to be obtained.

II. *Tubular boilers* have suffered much in reputation by being made too contracted in the water-ways, the tubes too close together, and the plates not sufficiently strong to resist the increased pressure used in them. They save both in weight and space, and are now designed quite free from the general objections made to them; they are not more expensive in fuel when a due proportion exists between the absorbent surface and the surface of the grates; and I know no reason why they should not be as durable as the ordinary flue boiler; they perhaps require more attention in blowing off, and keeping free from salt and earthy incrustation—that is all.

But the great saving is in the oscillating engine. If tubular boilers are objected to, we can have recourse to double tier flue boilers, which may be made with very slightly-increased weight and dimensions. The following Table will show the great improvements of late years in this branch of marine engineering:

Years made in.	Per Nominal Horse.	Contents of Boiler in Cub. Feet.	Contents of Steam Chests.	Total Contents.	Area of the Base of Boiler.
1818 to 1840	Ordinary single flue boiler, an average of 107 boilers	20.75	1.75	22.50	2.75
1840 to 1850	Double tier flue boilers, an average of 20 boilers	14.60	1.90	16.50	1.29
1840 to 1850	Tubular boilers as hitherto made	9.25	2.00	11.25	1.083

Therefore, making an allowance for the proper enlargement of tubular boilers for the purposes of ocean navigation, there will not be found any important preference over the double tier flue boiler.

III. *Eccentric, or feathering paddle-wheels* possess very important qualities; and although I adhere rigidly to the general opinions many years since expressed in print upon these wheels, as *then* constructed; they are now so much improved in manufacture and design as to have become *commercially* useful. They are nearly double the weight of common radial wheels, quite double the cost, and, so far as my experience goes, still give very great trouble and labor to repair. But for ships of variable draught, accustomed to contend with heavy seas, and also as conducive to the comfort of the passengers and crew, they are invaluable, and far beyond their extra cost; therefore I recommend their use for Atlantic navigation.

In a former part of this paper I referred to the Royal Mail Company (West India) who have lately entered into contracts to extend their fleet by the addition of five superb ships of upwards of 3000 tons displacement, having beams of 39 feet, and 270 feet long, drawing 19·6 when fully laden.

I have already expressed my deep regret that this Company should have contracted (with one exception) for the obsolete beam engine—flue boilers—and feathering or eccentric wheels. This they will assuredly regret; but having, I trust, fully shown the advantages to be derived from another course, I will devote the remainder of this paper to show what that Company will attain, and what they might have possessed with a less outlay—how they might have secured the greatest perfection, and how they have left open an opportunity for a vigorous and successful opposition to their earnest and sincere desires to uphold the permanency of their enterprise.

They have contracted for engines of 750 nominal horses power; now, as I have already stated that beam engines at 50*l.* per horse is not so lucrative an order as oscillating engines at 40*l.* per horse; hence they might have saved, 750 horses, at 50*l.* per horse, 37,500*l.*
 759 “ 40*l.* “ 30,000*l.*

or 7,500*l.* upon each pair of engines, or in the five ships, no less a sum than 37,500*l.*, or just the cost of one pair of beam engines!!

I need not say that the interest upon this amount is of some importance; or state the value of this sum as the nucleus of an insurance fund, and which this Company have hitherto found the use of in a more than usual degree. But the most important consideration will be the increased velocities of these ships, had they been fitted with machinery of the most improved and efficient kind.

I have already noted that their new ships are to have beams of 39 feet, and when laden and fully equipped for sea, on starting from Southampton are expected to draw 19 feet 6 inches of water.

The area of the immersed midship section will therefore be about 670 square feet.

We will also allow that the *indicator* power will be $2\frac{1}{2}$ times the *nominal* power, a very full proportion for beam engines to work safely under (unless they are made more than usually strong in the motive parts, as before explained.) We therefore have $750 + 2\cdot5 = 1875$ horses power.

It is well known by engineers that the power required to propel ships, is as the *cubes of the velocities*, and from an extended experience I assert, that the mechanical result may be represented by the factor 800, and it will be perfectly correct to take the area of the midship section (in each case) as the exponent of the resistance of the ship. Therefore the velocity will be

$$\sqrt[3]{1875 \times 800} = 13\cdot08 \text{ miles per hour.}$$

670
 This is, with beam engines of 23 cwt. per nominal horses power, or a total weight of 862·5 tons complete.

I have already shown that oscillating engines may be made to weigh but 14 cwt. per horse, and to exert three times the nominal power, without the slightest increase in the parts, and when so strengthened (an inexpensive process) may be extended to $3\frac{1}{2}$ times the nominal power. Therefore $750 \times 14 \text{ cwt.} = 525 \text{ tons}$, or a saving upon the beam engine of 337·5 tons dead weight!!

The power of the oscillating engine will be $750 \times 3 = 2250$ horses, and supposing the 337·5 tons on board in the

shape of CARGO (paying a heavy freight), the velocity would be,

$$\frac{\sqrt[3]{2250 \times 800}}{670} = 13.90 \text{ miles per hour.}$$

an increase of 0.82 miles per hour by the superior power of the oscillating engine alone.

But this comparison is faulty, because we have not accounted for the decreased weight of 337.5 tons.

From the magnitude of these ships, each inch of their immersion will be equal to *about* 20 tons. Therefore

$$\frac{337.5}{20} = 16.875 \text{ inches}$$

decrease in the draft, so that the area of the midship section will be reduced by the lighter but more efficient machinery, from 670 to 614 feet; and using the same formula we shall have

$$\frac{\sqrt[3]{2250 \times 800}}{614} = 14.31 \text{ miles per hour,}$$

or an excess over the beam engine of $(14.31 - 13.08) = 1.23$ miles per hour.

I take from an original prospectus of the Royal Mail Company, the route out and home at 10,500 statute miles, and though perhaps not absolutely correct, it will answer my purpose for an illustration of the advantages to be derived from improved machinery.

The beam engine will produce a velocity of 13.08 miles per hour—the oscillating engine, 14.13 miles (all things being the same). Therefore, this service would be performed by the former in $33\frac{1}{4}$ days, and by the latter in $30\frac{1}{4}$ days; and this saving of three days would be accompanied by the insurance fund of 37,500*l.*!

On the other hand, presuming that a cargo of 337.5 tons were taken on board, the voyage could be completed in $31\frac{1}{4}$ days,—a saving of two days, and the freight of the 337 tons of merchandise, which I leave others to set a value upon.

Applying these views and arguments to the Cunard's line of steamers, it is certain that if an average passage is now 11 days, it would become one of $9\frac{1}{2}$ or 10 days at the most.

I may, perhaps, not be fully understood by your general readers; but I recommend this paper to the careful consi-

deration of the profession, and to that of the powerful companies interested in the matter here discussed.

It would be a curious *finale*, if our brethren in American (far-seeing as they are) were to adopt the improvements now suggested. I believe that will be the result; and if they do, our boasted performances, as they now exist in ocean steam navigation, will be entirely eclipsed.

ON THE INCRUSTATIONS WHICH FORM IN THE BOILERS OF STEAM ENGINES.

(From a letter addressed to Dr. G. Wilson, F.R.S.E., by Dr. J. Davy. Read at the Edinburgh Meeting of the British Association.)

On entering on this inquiry, which I did after my return from the West Indies in December, 1848, and after communicating a short paper to the Royal Society "On Carbonate of Lime in Sea Water," it appeared to me desirable to collect as many specimens as possible of incrustation from the boilers of steam vessels, now so widely employed in home and distant navigation. * * * *
The character and composition of the incrustation, whether formed from deposition from water of narrow seas or of the ocean, I have found very similar—with few exceptions, crystalline in structure, and, without any exception, composed chiefly of sulphate of lime; so much so, indeed, that unless chemically viewed, the other ingredients may be held to be of little moment, rarely amounting to five per cent. of the whole.

* * * *

To endeavor to prevent the deposition of the incrusting matter or to mitigate the evil, various methods, it would appear, have been had recourse to—some of a chemical kind, as the addition of muriate of ammonia and sulphate of ammonia to the water in the boiler—without success, as might be expected;—others, of a mechanical kind, with partial success—as the introduction of a certain quantity of sawdust into the boiler, or the application of tallow, or of a mixture of tallow and plumbago to its inside, to prevent close adhesion, and the more easy separation of the incrusting matter either by percussion, using a chisel-like matter—or by contraction

and unequal expansion, by means of flame kindled with oakum, after emptying the boiler and drying it. Of all the methods hitherto used, that of "blowing off;"—that is, the discharging by an inferior stop-cock a certain quantity of the concentrated water of the boiler by the pressure of steam, after the admission above of an equivalent quantity of sea water of ordinary density, appears to be, from the reports made, the most easy in practice, the least unsuccessful, and the most to be relied on. But it can be viewed only as a palliation. Considering the composition of the incrusting matter and the properties of its principal ingredient—the sulphate of lime, a compound soluble in water and in sea water, and deposited only when the water containing it is concentrated to a certain degree, there appears to be no difficulty theoretically in naming a preventive. The certain preventive would be the substitution of distilled or rain water in the boiler for sea water. Of this we have proof in the efficacy of Hall's condenser, which returns the water used as steam, condensed, after having been so used:—but, unfortunately for its practical success, the apparatus is considered as being too complicated and expensive for common adoption. Further proof is afforded in the fact that the boilers of steamers navigating lakes and rivers in the waters of which there is little or no sulphate of lime, month after month in continued use, remain free from incrustation. This I am assured is the case with the steamers that have been plying several summers successively on the lake of Windermere. And it may be inferred, that in sea-going steamers in which sea water is used in the boiler—or, indeed, any water containing sulphate of lime, the prevention of deposition may be effected with no less certainty by keeping the water at that degree of dilution at which the sulphate of lime is not separated from the water in which it is dissolved. From the few trials I have made, I may remark that sulphate of lime appears to be hardly less soluble, if at all less, in water saturated with common salt than in perfectly fresh water. This seems to be a fortunate circumstance in relation to the inquiry

as to the means of prevention, and likely to simplify the problem. If these principles be sound, their application under different circumstances, with knowledge and judgment on the part of the directing engineer, will probably not be difficult. His great object will be in sea-going steamers to economize the escape of water in the form of steam, and thereby also economize heat and fuel;—also, when fresh water is available, to use it as much as possible; and further, to avoid using sea water as much as possible near coasts and in parts of seas where sulphate of lime is most abundant. From the incrustation on the boilers of sea-going steamers, the attention can hardly fail to be directed to that which often forms, to their no small detriment, in the boilers of locomotive railway engines, and of engines employed in mines, and in the multifarious works to which steam power is now applied. These incrustations will of necessity be very variable, both in quantity and quality, according to the kind of ingredients held in solution in the water used for generating the steam. Hitherto I have examined two specimens only of incrustations taken from the boilers of locomotive engines, and a single one only from the boiler of a steam engine employed on a mine—a mine in the west of Cornwall. The latter was fibrous, about half an inch thick, and consisted chiefly of sulphate of lime, with a little silica and peroxide of iron, and a trace of fluorine. The former were from one-tenth of an inch in thickness to one inch. They were laminated, of a gray color, and had much the appearance of volcanic tufa; they consisted principally of carbonate and sulphate of lime with a little magnesia, protoxide of iron, silica, and carbonaceous matter—the last two, the silica and carbonaceous matter, probably chiefly derived from the smoke of the engine and the dust in the air. From the engineer's report it would appear that the thinnest—the incrustation of about one-tenth of an inch—had formed in about one week, during which the engine had run over 436 miles and evaporated 10,900 gallons of water.—*London Chemical Gazette.*

On Atlantic Waves, their Magnitude, Velocity, and Phenomenon. By Dr. SCORESBY.

During two passages across the Atlantic in 1847-8, I had opportunities for investigating certain elements respecting deep sea waves more favorable than had ever before occurred within my experience in navigation. These observations, it should be noted in the outset, and the results deduced from them, were entirely uninfluenced by, and separate from theory. They form but a contribution to this interesting branch of natural phenomena; but I offer them the more readily from the circumstance of their entire independency and speciality. It was in our return voyage from America that the highest seas occurred, when the circumstances adapted for interesting observations were singularly favorable; for whilst the magnitude and peculiar construction of the upper works of the ship—the *Hibernia*—afforded various platforms of determinate elevation above the line of flotation for observations on the height of the waves, the direction of the ship's course, with respect to that of waves, was generally so nearly similar as to yield the most advantageous agreement or accordance for observations on their width and velocity. These observations I shall extract, in their order, from my journal kept during the homeward passage.

My first observation worth recording is under the date of March 5, 1848, when the ship was in latitude about 51° , and longitude (at noon) $38^{\circ} 50'$ W., the wind then being about W. S. W., and the ship's course, true, N. 52° E. At sunset of the 4th the wind blew a *hard gale*, which, with heavy squalls, had continued during the night; so that all sail was taken in but storm-staysail forward. The barometer stood at 29.50 at 8 p. m., but fell so rapidly as to be at 28.30 by 10 the next morning. In the afternoon of this day I stood some time on the saloon deck or cuddy roof—a height, with the addition of that of the eye, of 23 feet 3 inches above the line of flotation of the ship,—watching the sublime spectacle presented by the turbulent waters. I am not aware that I ever saw the sea more terribly magnificent. I was anxious to ascertain the height of these mighty

waves; but found almost every wave rising so much above the level of the eye, as indicated by the intercepting of the horizon of the sea in the direction in which they approached us, as to yield only the *minimum* elevation, and to show that the great majority of these rolling masses of water possessed a height of considerably *more* than 24 feet (including depression as well as altitude), or, reckoning from the mean level of the sea, of *more* than 12 feet. Exposed as the situation was, I then ventured to the larboard paddle-box, which was about 7 feet higher, where the level (as ascertained afterwards at Liverpool, allowance being made for the alteration in the draught of water of the ship,) was 24 feet 9 inches above the sea. This position, with 5 feet 6 inches, the height of my eye, gave an elevation altogether of 30 feet 3 inches for the level of the view then obtained,—a level, it should be remarked, which was very satisfactorily maintained during the instants of observation, because of the whole of the ship's length being occupied within the clear "*trough* of the sea," and in an even and upright position, whilst the nearest approaching wave had its maximum altitude. Here, also, I found at least *one-half* of the waves which overtook and passed the ship were far above the level of my eye. Frequently I observed long *ranges* (not acuminate peaks) extending 100 yards, perhaps, on one or both sides of the ship,—the sea then coming nearly right aft,—which rose so high above the visible horizon, as to form an angle estimated at 2 to 3 degrees (say $2\frac{1}{2}^{\circ}$) when the distance of the wave summit was about 100 yards from the observer. This would add near 13 feet to the level of the eye. And this measure of elevation was by no means uncommon,—occurring, I should think, at least once in half-a-dozen waves. Sometimes peaks of crossing or crests of *breaking* seas would shoot upward at least 10 or 15 feet higher. The *average wave* was, I believe, fully equal to that of my sight on the paddle-box, or more, that is, $\frac{39}{2}$ = 15 feet or upwards; and the *mean highest waves*, not including the broken crests, about 43 feet above the

level of the hollow occupied at the moment by the ship. Illuminated as the general expanse not unfrequently was by the transient sunbeam breaking through the heavy masses of the storm-cloud, and contrasting its silvery light with the prevalent gloom, yielding a wild and partial glare, the mighty hills of waters rolling and foaming as they pursued us, whilst the gallant and buoyant ship—a charming “sea-boat”—rose abaft as by intelligent anticipation of their attack, as she scudded along, so that their irresistible strength and fierce momentum were harmlessly spent beneath her and on her outward sides,—the storm, falling fiercely on the scanty and almost denuded spars and steam chimney raised aloft, still indicated its vast, but as to us, innoxious power, in deafening roarings, altogether presented as grand a storm-scene as I ever witnessed, and a magnificent example of “the works of the Lord,” specially exhibited to sea-going men, “and his wonders in the deep.” In the afternoon of the same day the gale again increased, blowing, especially during the continuance of a much protracted hail-shower, terrifically,—roaring like thunder whilst we scudded before it, causing the ship to vibrate as by a sympathetic tremor, and the tops of rolling waves, too tardy, rapid as was their actual progress, for the speed of the assailing influence, to be carried off and borne along on the aerial wings in a perfect drift of spray! But during the period of these most vehement operations of nature, I was fortunately enabled, from familiarity with sea enterprise, to pursue my observations with entire satisfaction.

The next day, March 6, added to the interest of these investigations by developing the character of the Atlantic waves under a long and fiercely-continued influence of a little varying wind. It had blown a heavy gale, violent in the showers, from the north-westward, from Saturday evening the 4th, to the evening of Sunday, from 26 to 30 hours; during the night, too, of Sunday, it had again blown hard (abating towards the morning of Monday), and making a total continuance of the storm, *in its violence*, of about 36 hours.* I renewed my ob-

servations on the waves at 10 A. M.—the storm having been then subdued for several hours, and the height of the waves having perceptibly subsided. Soon I observed, when standing on the saloon-deck, that ten waves, in one case, came in succession, which all rose above the apparent horizon; consequently, they must have been more than 23 feet, probably the *average* might be about 26 from ridge to hollow. At this period I also found that occasionally (that is, once in about four or five minutes), three or four waves in succession, as seen from the paddle-box, rose *above* the visible horizon; hence they must, like those of the preceding day, have been 30 feet waves. But one important *difference* should be noted—viz., that they were of no *great* extent on the ridge, presenting, though more than mere conical peaks, but a moderate elongation. Another subject of consideration and investigation, on this occasion, was the period of the regular waves overtaking the ship, and the determination, proximately, of the actual width or intervals, and their velocity. 1. The ship was then going *nine* knots only, the free action of the engines being greatly interfered with by the heavy sea running, and the lines of direction of the waves and the ship's course differed about $22\frac{1}{2}$ degrees, the sea being two points on the larboard quarter; in other words, the true course of the ship was east; the direction *from* whence the sea came was W. N. W.

2. The period of regular waves, in incidental series, overtaking the ship, were observed as follows:

Waves.	Min.	Sec.		Mean.
20 occupied	5	30	- -	16.5"
10 "	2	35	- -	15.5"
10 "	2	50	- -	17.0"
10 "	2	45	- -	16.5"
8 "	2	16	- -	17.0"

General average, 16.5"

3. The length of the ship was stated to be 220 feet. The time taken by a regular wave to pass from stern to stem appeared, on a mean of several observations, to be about six seconds. Hence, 6" : 220 feet (the width passed over in that time) :: 16.5 feet to 605 feet (the width passed over betwixt crest and crest). But this extent, by reason of the

* The barometer on Saturday, at 8 p. m., was at 29.50; at 6 a. m. of Sunday it had fallen to 28.30, being 1.2 inches in 10 hours. At 6 p. m. of the latter day it had risen to 30.00 inches.

obliquity of the direction of the waves to the course of the ship, is found to be elongated about 45 feet, reducing the probable mean distance of the waves to 559 feet. Independently of this process, I had previously estimated the distance of the wave crests, ahead and astern, when the ship was in the hollow, as I stood near the centre of the ship's length on the paddle-box, at 300 feet each way, by comparing the intervals betwixt my position and the place of the wave-crest, with the known length of the ship. This comparison, frequently reconsidered and repeated, subsequently yielded, in much accordance with the former, a total width in the line of the ship's course, of about 600 feet.

4. But the total distance betwixt the crests of waves, then reckoned at 550 feet, a distance passed by the wave in 16.5 seconds of time, by no means indicates, it is obvious, the real velocity of the wave, as the ship meanwhile was advancing nearly in the same direction at the rate of nine knots; that is, nine geographical miles, or $(6,075.6 \text{ feet} \times 9 =) 54,680.4$ feet per hour, or 15.2 feet per second. During the time, therefore, of a wave passing the ship = 16.5", the ship would have advanced on its course $16.5 \times 15.2 = 250.6$ feet. Reducing this for the obliquity of two points, we have 231.5 feet to be added to the former measure, 559 feet, which gives 790.5 feet for the actual distance traversed by the wave in 16.5 seconds of time, being at

the rate of $\left(\frac{3600'' \times 790.5}{16.5} \right) 17,251.7$

feet, or 32.67 English statute miles per hour. To know how far this result is but proximate, it should be considered that, of the several elements employed in the calculation, all but one might be deemed accurate.

The interval of time occupied by the transit of a wave with respect to the position of the ship, the *direction* of the ship's motion with relation to that of the waves, and the speed of the ship through the water, may all be recorded as essentially accurate. The element in doubt is that of the average distance from summit to summit of the waves. This distance, it has been seen, was by a twofold process of observation or comparison accordantly assumed. The value of the

judgment derived from rapid comparison of measures by an eye accustomed to such estimations is, it should be observed, far higher than might be generally considered. The practical military commander, or engineer officer, is able to make, by mere inspection of the ground before him, remarkably close estimates of spaces and distances. When engaged in the Arctic whale fishery, I was enabled, from habit and comparison of unmeasured spaces with known magnitudes, to estimate certain distances with all but perfect accuracy. Thus, as to a circumstance in which we were most deeply interested—the near approach of a boat to a whale—I found it quite practicable, whenever the pursuing boat approached within twice or thrice its length (except when the position was near end on) to estimate the distance to less than a yard. Now, the means of comparison by the eye as to the estimation of the breadth of the Atlantic waves, was that of the ship's length of 220 feet. When the ship was fairly in the middle of the depression betwixt two waves it was assumed, with reference to this known measure, that something obviously less, but not greatly so, than the ship's length, was the distance of each of the two waves then contemplated, giving a total width of about 600 feet. But the comparison of the time required by a wave to pass from stem to stern, with the average time of transit of an entire wave, yielded a much better result; and, on much consideration of the subject, I am inclined to believe that the estimate is a tolerably close approximation to the truth. It should be observed, too, that as the headway of the ship, in the direction of the course of the wave, being a known quantity, it was favorable to the accuracy of the estimate. For, assuming an error in the width of the waves to have occurred, say to the amount of one-twelfth of the whole, or 49 feet, the effect upon the calculated velocity of the wave would have been only about a sixteenth, or 2.16 miles per hour.

The form and character of these deep sea waves became at the same time interesting subjects of observation and consideration. In respect to form, we have perpetual modifications and varieties, from the circumstance of the inequality of operation of the *power* by

which the waves are formed. Were the wind perfectly uniform in direction and force, and of sufficient continuance, we might have in wide and deep seas waves of perfectly regular formation. But no such quality in the wind ever exists. It is perpetually changing its direction within certain limits, and its force, too, both in the same place and in proximate quarters. Innumerable disturbing influences are therefore in operation generating the varieties more or less observable in natural sea-waves.

In regard to my own observations of the actual forms of waves, nothing particularly new could be expected from an inquiry of this kind in regard to phenomena falling within the perpetual observation of sea-going persons; yet, at the risk of stating what might be deemed common, I will venture to transcribe from my notes made with the phenomena before me, the leading characteristics which engaged my attention. During the height of the gale (March 6th), the *form* of the waves was less regular than after the wind had, for some time, begun to subside. Though in many cases, when the sea was highest, the succession of the primary waves was perfectly distinct, it was rather difficult to trace an identical ridge for more than a quarter to a third of a mile. The grand elevation in such case sometimes extended by a straight ridge, or was sometimes bent as of a crescent form, with the central mass of water higher than the rest, and not unfrequently with two or three semi-elliptical mounds, in diminishing series, on either side of the highest peak. These principal waves, too, it should be noted, were not continuously regular, but had embodied in their general mass many minor, secondary, and inferior waves. Neither did the great waves go very prevalently in long parallel series like those retarded by shallow water on approaching the shore; but every now and then changed into a bent cuneiform crest with breaking acuminate peaks. On the following morning (March 7), after a second stormy night, wind S. S. W. (fine), we had a heavy and somewhat cross sea (from the change of wind from W. S. W. to S. S. W.). But the almost unabated magnitude of the more westerly waves indicated a continuance of the original wind at some distance astern of

us. The gale had moderated at daylight, and the weather became fine; but as the sea still kept high, its undulations became more obvious and easily analyzed. At three in the afternoon, when about a third part of the greater undulations averaged about 24 feet from crest to hollow, in height, these higher waves could be traced right and left as they approached the ship to the extent of a quarter of a mile on an average, more or less. Traced through their extent, the ridge was an irregular, roundbacked hill, precipitous often on the leeward side of waters. The undulations, indeed, as to primary waves, consisted mainly of these roundbacked masses, broken into or modified by innumerable secondary and smaller waves within their general body. The time in which these waves passed the ship was now, on an average, about 15 seconds, the ship's speed being increased from 9 to 11 knots, and the obliquity of the ship's course to the direction pursued by the waves was 3 points. On the 9th, two days after the above condition of the waves; whilst the sea yet ran high, few waves could be traced continuously above 300 or 400 yards in extent along the same ridge. The crests often curled over, but none so as to reach the height of a 30-foot wave, and broke for a wide space, estimated at 50 to a 100 yards in continuity.

MISCELLANEOUS NOTES AND SUGGESTIONS.—The mode adopted in these researches of finding the *height* of wave is, I believe, quite satisfactory, and, observed with care, and with relation to numbers, or proportion of waves, as accurate as need be. The depression of the horizon, in respect to the elevation of the observer, is too small to form even a correction. As the horizon from the paddle-box $\frac{39}{2} = 15$ feet, had only a depression of 3' 49", the distance of the visible horizon, as seen from this elevation, would be 4.45 statute miles, and the actual depression in feet due to the distance of the summit of the wave when the ship was in the midst of the hollow, could only be 0.18 foot or 2.16 inches. Other modes of determining the width of a wave—or the extent betwixt summit and summit—much preferable to that described (the only available one I could devise) might easily be adopted where the management of the ship was in the

hands of the observer. In steamships the simplest mode for high seas, perhaps, would be, altering the speed of the ship when going in the direction of the wave or against the wave; the ratios of the times of transit of wave-crests, under different rates of sailing of the ship, might yield results very close to the truth. In moderate-sized waves the plan adopted by Capt. Stanley seem satisfactory. But in calms, or moderate weather after a storm—that is, for the determination of the velocities of less elevated waves—a variety of processes might be available.

MISSOURI RIVER.

For Appleton's Mechanics' Magazine and Engineers' Journal.

The experimental surveys which have been made during the past season in the State of Missouri, to establish the route of the proposed Railroad from St. Louis to the western line of the State, enable us to give the rate of descent of a considerable section of the Missouri river.

From the mouth of the Missouri river, 18 miles above St. Louis, to Jefferson City, situated on the south bank of the river, and the capital of the State, the distance is by the river 150 miles, and the rise 124 feet. From the mouth of the Missouri to Kansas, situated immediately below the junction of the Kansas river, the distance on the river is 369 miles, and the rise 303 feet.

The city of St. Louis, is situated 18 miles below the junction of the Missouri and Mississippi rivers. The surveys above mentioned show the rise from St. Louis to Jefferson City to be 133 feet, the river distance being 168 miles; and the rise from St. Louis to Kansas 312 feet, the river distance being 387 miles. The fall of the Mississippi river from the junction of the Missouri to St. Louis, has been assumed to be six inches to the mile, or nine feet on that distance.

These data give the following rates of descent per mile, on this part of the Missouri river:

	Length, miles.	Fall, feet.	Descent per mile in inches.
Between Kansas and Jefferson City	219	179	$9\frac{3}{10}$
Between Jefferson City and the mouth . . .	150	124	$9\frac{2}{10}$
Between Kansas and the mouth	369	303	$9\frac{2.5}{10}$

Feet above tide.

The Mississippi river at the city of St. Louis, is assumed to be 335 feet above tide water of the Gulf of Mexico.	335
The correct height is known at the mouth of the Ohio, and 60 feet has been allowed for the fall from St. Louis to the Ohio, founded, for want of better information, on an estimate of the rate of descent of the river between these points.	
If this height be correct, the mouth of the Missouri will be above tide water	344
The junction of the Gasconade river with the Missouri, according to the surveys alluded to	436
The junction of the Osage river	459
The Missouri river at Jefferson City	468
The Missouri river at Kansas	647
The following heights are given by Mr. Charles Ellet, Jr., in his report on the improvement of the navigation of the Ohio river:	
The Mississippi river at the mouth of the Ohio river	275
The Ohio river at Louisville, above the falls	377
The Ohio river at Cincinnati	432
The Ohio river at Wheeling	620
The Ohio river at Pittsburg	699
The surface of Lake Erie	565

The following comparison of the rates of descent of these rivers is interesting:

	Lengths in miles.	Authority.	Descent per mile in inches.
The Mississippi river, from its mouth to the junction of the Ohio river	1178	Chas. Ellet, Jr.	$2\frac{8}{10}$
The Mississippi river, from the junction of the Ohio to the mouth of the Missouri . .	190	Assumed.	$4\frac{4}{10}$
The Missouri river from its mouth to Kansas	369	Pacific R. R. Survey.	$9\frac{8.5}{100}$
The Ohio river from its mouth to Pittsburg	975	C. W. Ellet, Jr.	$5\frac{2}{10}$
We add the most important tributaries of the Missouri river within the State of Missouri. The Maramec river from its mouth to the junction of the Bourbeuse river . .	84	W. H. Morell.	$13\frac{3}{10}$
The same from its mouth to the Maramec Iron Works	172	W. H. Morell.	$27\frac{2}{10}$
The Osage river from its mouth to the junction of the Niaugua river	108	W. H. Morell.	$6\frac{5}{10}$
The Osage river from its mouth to Osceola	$230\frac{1}{2}$	W. H. Morell.	$8\frac{4}{10}$
The Grand river from its mouth to the junction of the East Fork	69	W. H. Morell.	$8\frac{8}{10}$
The Grand river from its mouth to Gallatin, on the North Fork	110	W. H. Morell.	$10\frac{4}{10}$

The differences in the rates of fall of the Missouri and Mississippi rivers, explains to some extent the differences in the characters of the two streams.

The Mississippi below St. Louis would be considered by eastern men a turbid, muddy stream; but its waters are clear when compared with those of the Missouri river. The Missouri river carries so much earthy matter in suspension, as to render its waters opaque when examined in small quantities; the mud is apparent in clouds, and after subsidence the water is more turbid than that of the Lower Mississippi. Miss Bremer, the Swedish novelist, after a few days' travelling on the Mississippi, said that she felt "as if there was a small sand-bar in her throat." Our language would hardly have furnished her with an equally pithy caricature of the waters of the Missouri. The waters of the Upper Mississippi are clear and limpid for so large a stream. For many miles below the point where the two rivers meet above St. Louis, the waters run in the same channel without mixing, and the line which separates the muddy water of the Missouri from the transparent water of the Upper Missis-

sippi can be distinctly traced. After the waters have commingled, the Mississippi assumes a dull leaden look, which it maintains to the Gulf.

The valleys of the two rivers are very similar in character, within the limits of the data given above. The bottoms in both cases are composed, with few exceptions, of a rich, loose alluvium, formed of clay and sand in minute particles, easily undermined by the action of the water, and held in suspension at moderate velocities of the current. Through wide bottom lands of this character the river meanders from the Kansas to the Gulf of Mexico, constant only at points where the current bears upon rocks in site, situated on the extreme edges of this alluvial valley; at all other points within the valley proper, liable to change position with the irregular action of freshets, or with the slow and constant motion of the stream at each bend in its course. These changes in the course of the stream, and the undermining of the banks which precedes them, are not so frequent in the Mississippi as in the Missouri. The descent of the Mississippi is but $2\frac{8}{10}$ inches per mile; while the descent of the

Missouri, on the first 370 miles, is at the rate of $9\frac{8}{10}$ inches per mile. The destruction of the immediate banks of the Missouri at each divergence of the stream, the changes in its course, and the formation of new shoals, are in proportion to this greater rapidity of the current. Their effects, on a scale commensurate with the size of the river, occur annually on the Missouri after each spring freshet. The channel is constant only in those places where it bears upon the limestone and sandstone bluffs which define the valley. In its intermediate meanderings through its own loose deposits, its channel varies every fall, and the pilots on the river have to be constantly on the watch, during low stages, for these variations. The deposits formed in the eddies during freshets are immense. The low waters of summer encroach on these loose shoals, and carry much of their earths into the Mississippi; forming, besides, large shoals at the junction of the two rivers, where the velocity of the Missouri river is reduced.

The June freshet of the Missouri river is as regular as the rise in the waters of the Nile. It is occasioned by the melting of the snows of the upper country.

The rich bottoms of the valley are covered with a heavy growth of timber, and the size and age of this timber forms an index to the movements of the immediate channel of the river for a fixed time back. None of the pine varieties are to be seen in this part of the Missouri valley, nor in the countries bordering it. The trees are generally the cotton-wood, sycamore, elm, white oak, burr oak, pin oak, mulberry, walnut, hackberry, papaw and hickory. The firewood cut for steamboats consists almost invariably of the cotton-wood. The encroachments of the river root up, every season, numerous large trees. In certain parts of the river they lie thickly interlaced, and render the navigation intricate and dangerous at low stages of the water.

The rapidity of the current is judged to average from two to four miles an hour. In the rapid parts of the stream the steamboat moves very slowly, not more than from one to two miles an hour at such points. The average rate of the steamboats up stream, including stoppages, does not exceed four to five miles an hour; while in motion, they

probably make about six miles an hour. The boats run during the night when moving up stream; but when going down stream they lay by at night, unless in the highest stages of the water. The time made, therefore, down stream does not exceed that made up stream; and five miles an hour, including stoppages, but not including detentions on sand-bars, is a liberal allowance. The steamboat is less under control when working down stream than when moving up, and it is for this reason that boats do not run during the night when running down.

The tributaries of the Missouri which have been mentioned do not contribute to the muddy character of its stream, which is derived simply from the loose and exceedingly fine alluvial deposit over which it flows. The small streams which enter it are generally comparatively clear. The Osage is a clear stream, running on a pebbly bed, of about the capacity of the Connecticut river at Northampton. The Gasconade, a stream of about one-third less capacity than the Osage, is also perfectly transparent. We will mention here, as objects of curiosity in connection with these tributaries, two very large springs which occur in the limestone districts. The one best known forms the head of one of the forks of the Maramee river. It occurs in Crawford county, and furnishes the water power used by the Maramee Iron Company for their forges, rolling-mill, furnace-blast, flour-mill and saw-mill. This spring is, in fact, a river of water issuing from the limestone formation. The strata are laid bare where it flows out abruptly from the hill-side. The minimum delivery of the spring is, by measurement, 5658 cubic feet per minute. It maintains a nearly uniform temperature in summer and winter, and feels unpleasantly cold in summer and palpably warm in winter. The delivery varies with the season, and exceeds at certain times very much the summer flow. The water issues singularly transparent, and it is hence judged to be derived from an extensive and deep subterranean reservoir. It is avoided by the fish in summer on account of its comparatively low temperature then, and is, for an opposite reason, much frequented by them in winter. It forms a valuable water power on account of the uniformity of its supply, and possesses the further advantage of being

always free from ice in winter. This spring will become a place of great resort at some future time, when railroad communications shall make it of easier access to the travelling community. The beauty of the place, the purity of the water, the immense deposits of iron ore in the vicinity, and the extensive machinery for its manufacture which will by and by grow up, will all combine to render it peculiarly attractive. The other spring occurs on one of the upper branches of the Osage river. It is represented to be of equal magnitude, but there are no valuable mineral deposits known to exist in its neighborhood. One of the tributaries of the Gasconade river derives its supply from a similar but smaller spring, which is supposed by some, from the appearance of the water, to have a communication with one of the forks of the Bourbeuse river, some five miles distant.

To return to the Missouri river: it will have been already inferred by those of our readers who have not travelled on that river, that its navigation must be both tedious and difficult. During the months of January and February it is usually interrupted by ice, and during the months of September, October, and November, the water is so low and the channel then so intricate as to subject the boats to frequent detention by grounding on the shoals and bars. During this stage of low water regularity of communication is out of the question. Many of the boats, which frequent the river in its best stages, are laid up then, or withdrawn to other duties. The staple freights of corn, hemp, and tobacco, which accumulate at this season, cannot reach the market because few boats run the river, and the charges per freight are then very high. The wants of the travelling community are entirely beyond the accommodations which the river furnishes; and the wants of the farming and the mercantile interests, in regard to all kinds of freight, are most imperfectly and irregularly accommodated. These difficulties are not merely dampers to enterprise, but they disperse it: where greater conveniences of transit to market abound for the surplus fruits of their industry, men will prefer to congregate. The Missouri river could be improved as Mr. Ellet has proposed to improve the Ohio river,

though at an expense exceedingly greater; but an improvement of the river which should secure to it a fair depth of water during the dry months, which should defend its banks and confine its waters to one channel, which should remove all snags and drift-wood, and which should cut down all standing timber, likely to reach the river and reproduce such snags, —all these contributions to the perfection of its navigation would not secure a rate up stream of more than eight miles an hour, including stops, nor of more than 14 miles an hour down stream. It would be unwise to affect to despise river navigation because a more rapid means of communication has in our day been made available, but not less prejudicial to undervalue railroad communication in the great Western valley, because nature has supplied those immense fluid highways of the Missouri, the Mississippi, and the Ohio. The two means of communication are, in fact, equally the gift of nature; the one a result, accidental or intentional, of the physical laws of the globe, the other a result of the application of the reasoning powers of man to the laws of science, and the accumulated experiences of art. The economy of river navigation for heavy freights of small value moved at slow speeds, will probably always exceed that of the railroad, mile per mile, but for freights of great value and little bulk, and for personal travel, time enters as an element sufficiently important to secure to the railroad, where the river and railroad come into competition, the largest portions of those last descriptions of income. As the Mississippi valley becomes densely settled, the business which can be probably carried on each, will become better understood; the river and the railroad will respectively contribute to the development of the natural treasures of the lands, through which they pass, without interference with each other's peculiar rights. The river meanders through rich bottom lands, which cannot be threaded by railroads; the railroad passes over the rolling uplands which the river cannot reach, and but for the railroad would remain practically cut off from the centres of commerce and civilization. Were there no railroads, the cities of these rivers could afford to continue to receive their bounties with the exercise of as little effort to that end as heretofore, but the

railroad enables the cities away from the rivers, to share the advantages of the inland commerce, and to radiate lines of communication from their own centres more valuable to them than so many navigable streams. To maintain, therefore, their present position, and to preserve the large fixed capital sunk in the river cities, such as New-Orleans, St. Louis, Louisville, and Cincinnati, they must determine the principal lines of railroad to their marts by taking the lead in their construction.

We hope that Mr. Ellet's scheme, for the improvement of the Ohio river, will be fairly weighed and fairly tried, if the surveys recently ordered should confirm his views of its practicability; but the necessity for railroad communications between the most important cities in the valleys of the Mississippi and Ohio would not, therefore, be the less pressing. The wants of the community require the more rapid means of transit, and the eagerness with which it avails itself of railroad speed amply proves this. The economy of time which they permit, or the amount of previously dormant time, which they call into action, enlarges proportionally our spheres of industry and our fields of observation, increases our technical knowledge and suggests new applications of it, and adds vastly to our opportunities of healthy recreation and enjoyment. We add, indeed, by such economies of time to our length of life, if life may be measured by the sum of opportunities presented to us favorable to the acquisitions of information, wealth, enjoyment, and health.

The advantage of the railroad is mainly as an economizer of time, not as an economizer of present expense where time is no object. We will illustrate this by comparing the time occupied in travelling from St. Louis to Kansas on the Missouri river, with the time requisite to pass between the same points on a railroad.

	Hours.
The distance from St. Louis to Kansas is 387 miles, and the time occupied now by the boats when no accident occurs, averages, . . .	77
The time running down stream is not less, for reasons already given.	
The distance by railroad would be about 300 miles, and the time occupied by accommodation trains would be, . . .	15
and by express trains, . . .	11

We have here one day against three days in fair stages of the time, and in bad stages one day against four, five, and six days. The advantage is largely increased by the certainty of the one mode of transit, and the uncertainty of the other.

The distance from the mouth of the Ohio river at Cairo to New Orleans, presents another instructive example. The distance by the river is 1046 miles. The boats are assumed to run up stream, including stoppages, at the rate of eight miles an hour; and down stream, including stoppages, at the rate of 12 miles an hour. The distance from Cairo to Mobile by the Mobile and Ohio railroad, is 492 miles. If a connection were formed from New Orleans with the same railroad, the distance might be 550 miles. These distances, and the appropriate rates, will give the following times between New Orleans and Cairo:—

	Hours.
By the river <i>down</i> stream, ...	87
By the river <i>up</i> stream, ...	131
By the railroad accommodation trains, . .	27
By the railroad express trains, . . .	20

It would be superfluous to dwell on advantages so palpable; nor will any change in the improvement of the rivers, or rapidity of the boats, practically effect the comparison. The improvements in river navigation will, in all probability, be fully met by the many improvements of which railroad communications are even now susceptible. For speed, river navigation occupies already a subordinate place. In the transit of bulky commodities at low rates, where time is no object, it will probably maintain its present advantages, if it do not more probably, by being confined to this duty, increase it.

CARRICK.

St. Louis, Dec. 1850.

HUNTER'S WHEEL.

For Appletons' Mechanics' Magazine and Engineers' Journal.

Hunter's wheel, which is the subject of the following article, has never been adopted in any other vessels than those of the United States Government. The first vessel to which it was applied, was the war steamer "Union," of about 1,000 tons burthen. This vessel cost \$114,000

and had a mean sea-going speed of $4\frac{1}{2}$ knots per hour. She was a complete failure; and after performing a little steaming on our own coast, was finally condemned, and sent to Philadelphia for a receiving vessel.

Soon after the completion of the "Union," the Treasury Department decided on steam cutters, and applied Hunter's wheel to the "McLane," "Dallas," "Spencer," and "Bibb;" vessels of 147 feet deck, 23 feet beam, 14 feet hold, and 9 feet draft; the average cost being about \$90,000 each. All those vessels were likewise complete failures, and the Hunter's wheel was soon replaced by screw propellers, or common paddle-wheels.

Notwithstanding, however, the number of experiments which had thus been already made, and the uniformity and totalness of their failure,—notwithstanding the deductions of science and the results of practice, the Navy Department decided upon the construction of another war steamer to be propelled by Hunter's wheel. The new vessel was the "Alleghany." She was of iron, and has made her first, and probably last cruise, the results of which will be found investigated in the following pages.

A board, composed of two chief engineers of the navy, the engineer of the Washington navy-yard, the chief naval constructor, and a commander in the navy, recently examined and reported upon the vessel by order of the Secretary of the Navy. Their report was the total condemnation of Hunter's wheel, and a recommendation to substitute for it the common paddle-wheel. In view, then, of the above facts, this system of propulsion may be considered as definitively exploded; and I have consequently no hesitation in giving the following article for publication, as it cannot therefore injure any private interest:

Investigation of the results obtained from "Hunter's submerged wheel," as applied to the U. S. steam-ship "Alleghany."

This propeller consists of a plain drum, $10\frac{1}{2}$ feet diameter by 42 inches in depth. Upon the sides, or periphery of this drum are placed radially, four rectangular plane surfaces or paddles of the same depth (42 inches), and 26 inches

broad. These plane surfaces act identically as the paddles of a common paddle-wheel, excepting that the common paddle-wheel is revolved vertically, while Hunter's wheel is revolved horizontally—a difference not at all affecting the principle of its action.

In order that this instrument may propel when submerged, it is inclosed in a closely fitting case (there being a play of two inches allowed in every direction), except at the side of the vessel, where the interior of the case communicates with the outside water, and where the paddle, at right angles to the keel, projects its whole breadth of 26 inches. The case is of course water tight, and with its contents occupies its bulk in the hold of the vessel. The paddles are of such a number (4), relatively to the segment of their periphery traversed in the water, that there is one paddle in action when one is just emerging from, and its immediate predecessor is just immersing in, the case.

The object of this construction is easily understood. If such a wheel were immersed in water without its case and revolved, the action of opposite paddles would neutralize each other, and there would result no progressive motion; but by inclosing all, except the one in action, the reaction of the remaining inclosed paddles is against the case, and its influence is only felt in the loss of the labor expended in sweeping around within the case, a mass of water equal to its capacity; which loss goes to increase the slip of the wheel and is estimated by such increase of slip. This is obvious from the consideration, that the effect of any increase of load upon the propelling instrument is to increase its slip, and the resistance of such increase of load will be accurately measured, by the increase of slip. In this manner the resistance of *tows* and head winds upon steamers may be measured.

I use the expression *loss of labor*, in preference to *loss of power*, as more logical in language and also as strictly in fact (which the other is not), for it is manifestly impossible that there should be any *loss of power* under any circumstances, though there may be *loss of labor*. The power will always produce its full effect, but whether the *whole* of that effect is expended in producing the

desired result depends upon various conditions. If the power be expended in producing results useless for the purposes we have in view, a *loss of labor*, though not a *loss of power*, is experienced.

Let us now ascertain what *kinds* of losses of labor will ensue from the use of Hunter's wheel.

In the first place, as its mode of action is identical with that of the common paddle-wheel, it will, like the common paddle-wheel, have losses by slip and oblique action, which must be calculated for both wheels in the same manner. In making this calculation, the side of the vessel occupies the same position relatively to Hunter's wheel, that the surface of the water does to the common paddle-wheel. But as the paddles of Hunter's wheel revolve, they sweep within the case the mass of water included between the paddles, on entering, and throw it out on leaving: there are then the additional losses of the momentum of this water so carried around (which increases the slip), and its friction on the top, bottom, and sides of the case, and top and bottom of the drum. The relative *quantities* of these losses will be occasioned by a comparison of the "Allegany" with the "Republic," a steamship of about equal size; and as reliable data is possessed of both ships, reasonable confidence may be placed in the results obtained.

The following are the dimensions of the "Allegany." Length on deck 185 feet. Beam on deck $33\frac{1}{3}$ feet—at wheels 25 feet. Depth of hold 19 feet. Mean draught of water 12 feet. Immersed amidship area 262 square feet. Displacement 1,020 tons.

The mean speed of the "Allegany" during her cruise from Norfolk, Va., to the Mediterranean and back, as taken from her Log, was, for 87 hours steaming in calms and a smooth sea—being the total amount of steaming done in calms—5.97 knots per hour. The knot being taken in the British and American navies at $6,082\frac{2}{3}$ feet, this speed of the "Allegany" would become 6.878 statute miles per hour. Mean revolutions of the wheels per minute 30. Mean effective pressure in the steam cylinder 14 pounds per square inch.

The engines were condensing, direct acting, and consisted of two steam cylin-

ders, 60 inches in diameter and 4 feet stroke, and developed 574.76 actual horses power.

The following are the dimensions of the "Republic." Length on deck 207 feet. Beam on deck 30 feet. Depth of hold $18\frac{1}{2}$ feet. Mean draught of water 12 feet. Immersed amidship area 278 square feet. Displacement 1,200 tons.

The mean speed of the "Republic" in calms, as noted accurately from points in Chesapeake Bay, is 11 statute miles per hour. Mean revolutions of the wheels 15 per minute. Mean boiler pressure above atmosphere 15 pounds, used with an expansion of twice, gave for a mean effective cylinder pressure 18.43 pounds per square inch. The same allowance of two pounds less initial cylinder pressure than boiler pressure, and the same back pressure of 4 pounds on the piston being made for the "Allegany" and "Republic."

The engines were condensing, oscillating, and consisted of two steam cylinders 54 inches diameter and 6 feet stroke, and developed 485.44 actual horses power.

As the proportions between length and beam were about the same with both vessels, the relative excellence of the models, that is, the fineness of the water lines, can be measured by their displacements, compared with their immersed amidship sections: viz.,

$$1,200 : 278 :: 1,020 : 262 \text{ and} \\ 1,200 \times 262 : 1,020 \times 278 :: 1,109 : 1,000$$

But the sharpness of the water lines measures not only the quantity of water displaced, but also the resistance it offers to displacement. The relative resistances then of the hulls in function of model will be as the squares of 1,000 and 1,109, that is, as 1.00 to 1.23. Now the relative masses of water moved will be measured by the immersed amidship sections; viz., as 262 to 278, or as 1,000 to 1,061.

The coefficients representing the total relative resistances of the hulls will then be compounded of the resistances in function of model and of mass: viz.,

$$\text{For the "Allegany," } 1,000 \times 1,000 = 1,000 \\ \text{For the "Republic," } 1,230 \times 1,061 = 1,305$$

Let us now ascertain the losses of labor by the "Republic."

The speed of the vessel was 11 statute miles per hour, or	Feet per hour.
Speed of the centre of reaction of the paddle (diameter of circle of reaction 24 feet),	58,080
Slip, ...	67,851
or 14.4 per cent.	9,771

The Republic's paddle-wheel was 25 feet diameter from outside to outside of paddles. The paddles were $8\frac{3}{4}$ feet long by 27 inches broad, and their lower edge had a mean immersion of 5 feet. The loss of labor by the oblique action of the paddles, calculated as the squares of the sines of the angles of incidence of the paddles upon the water, was 19.1 per cent.

Estimating the power required to work the engine, that is, to overcome the friction of the working parts at 5.5 per cent., and the load upon the air-pump piston at one pound upon the steam piston =

$$\frac{100.00}{19.43} = 5.15 \text{ per cent., and the friction}$$

of the load of the vessel upon the engine journals at 10 per cent., which is the mean of the best experiments; and we have the following.

Disposition of Power for the "Republic."

	Per cent.	Actual horses.
Slip of the centre of reaction of the paddles,	14.40 or	69.90
Oblique action of the paddles, ...	19.10 "	92.72
Working engine and air-pump, ...	10.65 "	51.70
Friction of load, ...	10.00 "	48.54
Leaving to be utilized in propelling hull of vessel, ...	45.85 "	222.58

Totals, . 100.00 " 485.44

From the above "disposition of power" in the "Republic," we can ascertain the "disposition of power" in the "Allegany;" and first, let us ascertain the power required to propel the "Allegany" at her speed of 6.878 statute miles per hour. Now the power required to propel the "Republic" at her speed of 11 statute miles per hour is 222.58 horses, and supposing the hulls of the two vessels to have equal coefficients of resistance, the power required to propel at the different speeds would be as the cubes of the speeds; viz.,

$$11^3 : 222.58 :: 6.878^3 : 54.42 \text{ horses.}$$

But the coefficients of resistance were not equal: they were 1.305 for the "Republic," and 1.000 for the "Allegany," therefore $\frac{54.42}{1.305} = 41.7$ horses required to propel the "Allegany."

The circumference of the circle of the centre of reaction of the "Allegany's" wheels was 42.223 feet; the slip was, therefore, as follows.

	Ft. per hour.
Speed of vessel 6.878 statute miles per hour, or	36313.53
Speed of centre of reaction of paddle, ...	76001.40
Slip, ...	39687.87

or 52.22 per cent.

The loss of labor by the oblique action of the paddles, calculated as for the "Republic," is 12.35 per cent.

The power required to work the engine, estimated as for the "Republic" at 5.5 per cent., and the load upon the air-pump piston at 1 pound per square inch upon the steam piston = $\frac{100.00}{14.00} = 7.14$ per cent., makes a total for the engine of 12.54 per cent.

The power required to overcome the friction of the load, estimated as before, 10 per cent.

The remainder of the power will be that absorbed by the friction of the water on the surfaces of the wheel cases and drums. The power required to move around the water within the cases, is already necessarily calculated in the slip.

We shall then have for the "Allegany" the following

Disposition of Power.

	Per cent.	Actual horses.
Slip of the centre of reaction of the paddles,	52.22 or	300.66
Oblique action of the paddles, ...	12.35 "	71.10
Working engine and air-pump, ...	12.54 "	72.20
Friction of load, ...	10.00 "	57.57
Utilized in propelling hull of vessel, ...	7.24 "	41.70
Friction of water on surfaces of cases and drums, ...	5.65 "	32.63

Totals, . 100.00 " 575.76

A little reflection will show the impossibility of calculating the friction of the water on the surfaces of the wheel cases and drums, in any other manner than the above. With regard to the sides of the cases, as the paddles do not revolve within two inches of them, there will remain a layer of water of that thickness, not put in motion by the revolutions of the paddles, but solely by the friction of the water carried around between the paddles. The friction will, therefore, be that of water on water with the velocity of the periphery of the paddles, and the friction of the layer of water on the side of the case with the unknown velocity communicated to it by the water revolving with the paddles—evidently a much less velocity. With regard to the top and bottom of the cases for the spaces immediately above and below the paddles—that is, for a space 26 inches wide—there is the same interposed layer of water: and for the space extending inwards from this to the axis—that is, for the diameter of the drum—the friction will be that of iron on water for the velocity of the drum top and bottom, and for the unknown velocity of the water put in motion by the friction of the drum top and bottom on the top and bottom of the case immediately over and below the drum. By no known data can these frictions be calculated independently.

Let us now compare the results from the “Allegany” and “Republic,” multiplying their actual powers by the coefficients, inversely, of the resistance of their hulls for the expression of the power; and taking the cubes of the speeds as the measures of the effects:

	Coefficients of hulls, inversely.	Actual horses power.	Expression for power.
Allegany,	1·305	575·76	751·37 or 1·0000
Republic,	1·000	485·44	485·44 “ 0·6461

And,

	Powers.	Speeds.
Allegany,	1·0000	6·878 ^s or 1·000
Republic,	0·6461	11·000 ^s or 4·096
And	$\frac{4·0960}{0·6461} = 6·324$	

That is, the application of the power was better in the “Republic” than in the “Allegany” in the proportion of 6·324 to 1·000.

Again, making the comparison in another manner, viz., by the per centages of the power *utilized* for propelling the vessels, in the two systems, we have

For the Allegany, 7·24 per cent.
For the Republic, 45·85 “ “

and $\frac{45.85}{7.24} = 6.333$, or almost exactly the

same as above. The close accordance of these results leaves no doubt as to the accuracy of both data and calculations.

Enormous as is the difference between the results thus obtained from the “Allegany” and “Republic,” it is no greater than what might have been predicated from the dimensions of Hunter’s wheel relatively to the hull of the “Allegany” and to its submerged position. The data for the calculation could have been obtained from any sea-going paddle-wheel steamship of appropriate size and known performance—that is, known slip.

If water offered an unyielding resistance to the impact of the propelling surface, the area of that surface would be a matter of indifference; but as water opposes a yielding resistance, a sufficient quantity of it must be embraced to obtain the desired reaction for the propelling surface, by reason of which reaction the vessel advances. Now, in the proportion that the water yields before the propelling surface, is the vessel’s loss of speed normal to that surface: part of the power is expended in giving motion to the vessel, part in giving motion to the water; and in proportion to the speed of the vessel and water. In the “Republic,” the mean amount of its propelling surface in action, projected in line of keel, was 138·40 square feet. In the “Allegany,” the mean amount of similar surface, similarly projected, was 11·50 square feet. The coefficient of resistance for the hull of the “Republic” being as 1·305 to 1·000 of the “Allegany,” in order that the wheel of the latter should have the same slip as the wheel of the former, the propelling surface of the former should be reduced in that proportion, or become $\frac{138.40}{1.305} = 106.054$ square feet, provided

the velocities of the respective centres of reaction were the same; because the propelling efficiency of a given surface is as the square of the velocity with which it

strikes the water. Now the velocity of the centre of reaction of the "Republic's" wheel was $(75.4 \text{ feet} = \text{circumference of centre of reaction} \times 15 = \text{number of revolutions of the wheel per minute})$ 1131.00 feet per minute. The velocity of the centre of reaction of the "Allegany's" wheel was $(42.323 \text{ feet} = \text{circumference of centre of reaction} \times 30 = \text{number of revolutions of the wheel per minute})$ 1266.69 feet per minute, and the squares of 1131.00 and 1266.69 are in the proportion of 1.000 to 1.254; therefore the 106.054 square feet must be decreased

in that proportion, and $\frac{106.054}{1.254} = 84.573$

square feet; which should have been the amount of projected propelling surface given to the "Allegany's" wheel, moving at the velocity of that wheel, in order that the "Allegany" should give the same slip as the "Republic;" provided again, that the centres of reaction of the paddle surface of the two wheels were at the same depth below the surface of the water. Now the centre of reaction of the "Allegany's" paddles was 7 feet below the surface of the water, while the mean of the centres of reaction of the *propelling* paddle surfaces of the "Republic" was only 3.75 feet below the surface of the water. Now the pressure, resistance or reaction of water, is directly as its depth, the above obtained 84.573 square feet of surface for the "Allegany" must be further diminished as 7.00 to 3.75, when it will become 45.307 square feet, which would have been the proper surface to have given a slip of 14.4 per cent., the same as the slip of the "Republic's" wheel. Now the actual projected propelling surface of the "Allegany's" wheel was 11.5 square feet, and its slip 52.22 per cent.; and $\frac{45.307}{11.5} = 3.931$; and $\frac{52.22}{14.4} = 3.626$. In

other words, a propelling surface of $\frac{1}{3.931}$ gave 3.626 times the slip, when according to our calculations it should have given 3.931 times the slip; a very slight discrepancy, or rather a very wonderful accordance; and even this slight discrepancy is diminished, when something is allowed for the greater distance apart of the paddles in the "Allegany" than in the "Republic,"—that distance being about double. For all practical purposes, then,

our calculations sufficiently approximate the truth.

There is, however, another objection to Hunter's wheel, entirely apart from its demerits of contrivance, viz., its location. It is placed *within* the hold of the vessel, and of course occupies a large per centage of its total capacity; and this is particularly unfortunate in steamers, where the great difficulty is to obtain space for the machinery and fuel. This disadvantage, which is peculiar to it, should alone be conclusive against its use, when the enormous size of the wheel cases are considered, and from this proceeds principally its cause of such utter failure; for it is not possible to give it sufficient paddle surface, so as reasonably to reduce the loss by slip, without entirely filling up the ship with wheels; and even in that case, the loss by friction is increased in proportion to the increased surface of wheel case. The contents of the present wheel cases, are about 1320 cubic feet. The weights of the wheel cases and contents are equivalent to a displacement of 69 tons in round numbers. If the paddle surface were now so increased as to give a slip of 14.4 per cent.; that is, increased 3.931 times, the wheel cases and contents would operate a displacement of 230 tons, or $22\frac{1}{2}$ per cent. of the total displacement of the vessel; this space would be taken from the centre of the ship, where it is most valuable, the contracted spaces at the ends of the vessel being of but little use.

Taking the weight of the "Allegany's" hull at 400 tons, which is very near the truth, and deducting it from the total displacement of the vessel, viz., 1020 tons, there will remain 620 tons useful displacement for the weights to be carried; of this 620 tons, 230 tons or 37 per cent. being over $\frac{1}{3}$ d, would be occupied by the wheels alone. Nor does the difficulties in the way of increasing the paddle surface stop here; the engine, with the reduced slip of wheel, must, in order to give the same number of revolutions per minute, which is necessary for the propelling efficiency of the paddles to remain as taken, be increased in size, preserving the same mean effective pressure in the cylinder as at present. The boiler to supply this enlarged engine must also be proportionally enlarged, and the coal-bunker room must likewise

be increased in the proportion of the squares of the speed as it is and as it would be, in order to be able to steam the same distance. When then these increased weights and bulks are placed within the vessel, there would remain but little capacity for any thing else, and the ship would of course be rendered wholly inefficient for any useful service.

It has been asserted that the buoyancy of the drums is equal to the weight of the wheels, cases, &c. This is of course on the presumption that the drum will remain water tight; a thing, practically, almost impossible. The drum is constructed of plates of boiler iron, riveted together, and calked as boilers usually are. Now it is well known, that the best built boilers leak a little when perfectly new and filled with water, without steam pressure. The slightest leak—a mere trickling of drop by drop, would soon fill the drum, and when filled, it remains so, as it is impossible to empty it. We will admit, however, that the drum is water tight. Its buoyancy would then be 45,600 pounds. The weight of a single wheel, with its case, &c., is, from the accounts rendered to the Navy Department, 34,290 pounds. The mass of water contained in each case, between the case and drum, is, in round numbers, 21,000 pounds.

The total weights of one case and contents, on the supposition that the drum is water tight, is $34,290 \times 21,000$.	} = 55,290 pounds.
Buoyancy of drum,	
	21,600 "

Excess of weight over buoyancy,	} 33,690 "

The truth however, is, that the drum soon fills with water, and the weight of each case with its contents then becomes 76,890 pounds.

The drum of the "Union's" wheels was packed with cork, on the absurd supposition that when it filled with water the cork would render it buoyant; not considering that when the pores of the cork became filled, the total weight would be greater than if water alone were present.

Hunter's wheel combines in itself all the peculiar disadvantages of the common paddle-wheel and screw; viz., the loss by oblique action of the common paddle-

wheel, and the screw's loss by the friction of the screw surface on the water, together with the loss by slip—common to both—but excessively exaggerated in Hunter's wheel. In addition to these, it has its peculiar disadvantage of location. Being submerged, it cannot be repaired without docking the ship—an inconvenience in common with the screw; but with Hunter's wheel, not only must the ship be docked, but a water tight iron case broken open, and all the intermediate parts of the machinery disconnected, before repairs or even an examination can be made. Of course, after the work is done, the broken part of the case must be remade, and the connections re-formed. In compensation for all these enormous losses and inconveniences, there is absolutely nothing, excepting that the apparatus is submerged, and consequently protected from shot—an advantage enjoyed in common with an infinity of plans for submerged propulsion,—none of which, it may be safely affirmed, are inferior to this economically or potentially.

In conclusion, it is not unworthy of remark, that the cruising recorded in the log, from which the vessel's speed and engine power has been taken, was performed under the command of Lieut. Hunter, U. S. N., the patentee.

B. F. ISHERWOOD,
Chief Engr. U. S. N.

BALTIMORE, December, 1850.

PHOTOGRAPHY ON GELATINE:—MEANS OF OBTAINING VERY CLEAR AND VERY TRANSPARENT NEGATIVE PROOFS, CAPABLE OF BEING TRANSFERRED A GREAT MANY TIMES ON ORDINARY PHOTOGRAPHIC PAPER. BY M. A. POITEVIN.*

In order to prepare the layer of gelatine on which I make my negative proof, I dissolve in 100 grammes of water 6 grammes of gelatine of good quality (that which is met with in commerce, and which is used for preparing jellies for food succeeded best). This size should not contain salts soluble in water; it should also be as free as possible from fatty matters. To make the solution, I steep the gelatine in distilled water for 10 or 15 minutes; I slowly heat over a

* *Comptes Rendus*, No. 21, 27 May, 1850.—*Chemist*, July, 1850.

spirit lamp, and agitate continually until the solution is complete. If any scum forms, I carefully remove it by means of blotting paper, which I draw over the surface; I strain it through a very fine cloth, previously dampened, and I again skim the surface on which a few striæ form, arising, doubtless, from fatty matters which escape the first skimming.

The gelatine being thus prepared, I take, with a graduated pipette, a determinate quantity, and I run it over a very even plate of glass placed horizontally; a layer of 1^{mm}·50 is sufficient; this quantity is equivalent to nearly 20 centimetres of solution for a surface of half a plate having 13^{cm}·5 or 17^{cm}·5. A thicker layer would not be injurious, but a thinner one might present some inconveniences.

Before running the gelatine on the glass plate, a thin layer is applied to it by means of a cloth impregnated with a solution of gelatine, rather more dilute than the foregoing; afterwards, the glass plate is gently heated by means of a spirit-lamp; then the solution of gelatine is run on, and flows uniformly over the plate. The under side of the glass plate is again heated, but with moderation, in order to give fluidity to the gelatine, and is allowed to cool.

The plate being thus prepared, I plunge it into a solution of acetate of silver, keeping the surface covered with gelatine underneath, and inclining it in the solution until the latter has completely moistened it; I then turn the glass plate and immerse it completely in the solution; then I pass a very soft pencil several times, and in different directions, all over the gelatinized surface, in order to dispel the bubbles of air which may adhere to it, and, before withdrawing it, I blow on the surface to ascertain whether the solution has moistened it all over. I then remove the plate, and holding it somewhat inclined, I pass the pencil already used over the whole surface, taking care to cover the edge of the previous stroke with that of the following one. I then dry the under side of the plate and place it horizontally until the surface is dry, which requires five or six hours.

I ordinarily prepare over-night the plates which I intend to use on the following morning, and in the morning those which I mean to use in the evening. It is important that no free liquid

should be left on the surface of the plate when it is required for use, for the preparation would be removed at the places where any remained. This preparation should be made out of the solar light. The plate covered with the solution of acetate of silver should be kept out of the light.

The solution of acetate of silver is prepared by making a saturated solution of acetate of silver, to which half its bulk of water is added. Admitting that 100 parts of water dissolve, at the ordinary temperature, 0·5 gr. of acetate of silver, to prepare 0·750 lit. of the solution which I use, I dissolve 2·5 gr. of acetate of soda in 15 grammes of water; I likewise dissolve 3·03 gr. of nitrate of silver in 10 grammes of water; I add the solution of nitrate of silver to the solution of acetate of soda, and I receive the acetate of silver which is precipitated on a filter; I wash the precipitate in a stream of water, then I pass through the filter several times 0·50 lit. of water; almost the whole of the acetate of silver should then be dissolved; I afterwards add 0·25 lit. of water to the half litre of saturated solution.

In this operation, 3 grammes of acetate of silver are formed, the 0·75 lit. should contain only 2·50 gr., but I put in a little more of it to make up for any that may have been lost in the water of the solutions and of washing. The acetate of silver being very easily altered by the solar light, I make this solution as far as possible in a dimly lighted place. I preserve it in a bottle covered with black paper, and filter it every time I use it.

I expose the plate prepared as above described to the vapor of iodine, in the same manner as a plate of silvered copper; only, for this exposure, account must be taken of the time, for we cannot judge of the tint on the surface, only the time of exposure is shorter than for silvered plates. The iodized plate is placed in the frame of the camera obscura, and then I cover the side which is not gelatinized with a piece of card-board covered with black cloth. It is good to allow some time to elapse between the iodizing and the exposure to the focus of the camera; the plate thereby gains in sensibility. I have sometimes used plates five or six hours after the iodizing; they had lost nothing of their sensitiveness.

The sensitiveness of these plates is about one-fourth of that of plates prepared with iodine and bromine. For a landscape with much light and with an object-glass with a small diaphragm, the exposure in the camera may require from 80 to 100 seconds. Portraits, with strong lights and shades, may be taken in two minutes with the portrait object-glass. I have tried the effect of the vapor of bromine on these plates, and have found that it renders them more delicate. I have not made sufficient experiments to have certain data on this subject.

In order to make the image appear, I plunge the plate into a solution of gallic acid containing 0.1 gr. of gallic acid in 100 grammes of water; I leave the proof until the shadows appear sufficiently intense. This immersion may last an hour or an hour and half. With a more concentrated solution of gallic acid, it would require a shorter time, but it would be more difficult to regulate its action. At the commencement of the immersion, a positive image is formed on the surface of the gelatine. This image becomes more and more dark; but, on looking through it, the parts corresponding to the shadows in nature remain very light.

To fix the proof, it is washed in ordinary water, and then left for about a quarter of an hour in a solution of 1 gramme of hyposulphite of soda in 100 grammes of water; it is again washed in ordinary water, and it is steeped for the same length of time in a solution of 1 gramme of bromide of potassium, in 100 grammes of water.

I wash the proof with ordinary water, allowing it to remain in it for fifteen or twenty minutes; then I wash with distilled water, and allow the layer of gelatine to dry in the open air. It is then a very clear negative proof, capable of giving positive proofs, with ordinary photographic paper, in the sun, in from 2 to 10 minutes, according to the vigor of the negative proof; it also comes very well in the shade.

It is well to renew, at each operation, the solutions of gallic acid, hyposulphite of soda and bromide of potassium.

In this operation, if the solution of gallic acid be replaced by a solution of sulphate of protoxide of iron, very beautiful positive proofs are obtained.

PHOTOGRAPHY ON PAPER.—MEANS OF OBTAINING THE IMAGE IN THE CAMERA OBSCURA ON DRY PAPER.* BY M. BLANQUART-EVRARD.

To render the execution of photography on paper simple, sure, and easy to those least experienced in chemical manipulations, should be the object of the efforts of those who wish to bring this art to its most useful application in industrial economy. The first condition for entering into this new order of things, is to rid the operation of the care which it requires at the time of the exposure. We open the way by giving here:—

1. The means of operating on dry paper, instead of damp paper, freeing the operator from the difficult preparations which he has to make at the places of exposure.

2. So simple a mode of preparing this photogenic paper, that it may be manufactured, and sold to the amateur who does not desire the trouble of preparing it himself.

The papers prepared by the means hitherto described, could not be brought to the dry state without afterwards taking, under the action of gallic acid, a uniform coloration which would efface the photogenic image, and cause it to completely disappear. Serum has the property of obviating this inconvenience; the following is the mode of preparation to be adopted:—

Collect, by filtering, the clear part of milk which has been turned, and beat up in this serum the white of one egg to each pint, then boil in order to remove all the solid matters, and filter again, after which dissolve without heat 5 per cent. by weight of iodide of potassium. The paper to be prepared must be very thick, and steeped entirely in the liquid for two minutes, and afterwards dried by hanging it, by means of two pins, by two of its corners, to a line.

This preparation is made in the daylight, without any particular precaution; the paper is fit for immediate use for six months after, and certainly after a much longer time. When it has to be used, it is submitted to a second preparation,

* *Comptes Rendus*, No. 21, May 27, 1850.—*Chemist*, July, 1850.

which is done by candlelight, and as short a time as possible before the exposure; it is, however, still capable of giving good results several days after, avoiding then, as much as possible, leaving it in a high temperature.

We proceed therefore in this preparation, by covering a glass with aceto-nitrate of silver composed of one part of nitrate of silver, 2 parts of crystallizable acetic acid, and 10 parts of distilled water. On this substance is deposited one of the sides of the paper, which is allowed to imbibe until it has become perfectly transparent, which is ascertained by raising it between the operator's eye and the candle, after which it is dried between several folds of very white blotting paper, and left so until it has to be placed in the frame, behind a sheet of very clean and dry paper, and between two glasses, as in the moist operation previously described.

The exposure to which we afterwards proceed next day, varies according to the light and the power of the object-glasses, from one to five minutes.

On returning to work, the part of the paper which has been presented to the light is deposited in a saturated layer of gallic acid, taking care to secure the other side from any trace of gallic acid, which would stain it. The image is gradually formed, and finally acquires as powerful tones as can be desired; it is then washed in a great quantity of water, then parts into a solution composed of 1 part of bromide of potassium and 20 parts of water, in order to dissolve the unreduced salts of silver, then again washed to remove all traces of this bromide, whose action, by continuing, would destroy the image, and finally dried between folds of blotting paper.

Preparation of the Dry Albuminous Paper.—The paper prepared by albumen has analogous properties to that in the preparation of which serum is used, but in an inferior degree; like it, it remains good for an almost indefinite period after the preparation with the iodide, but, after having been submitted to the aceto-nitrate of silver, it can be scarcely kept beyond next day. The proofs given by the preparation we are

about to describe are admirable; not so fine as those on glass, they have more charms, because the contrasts are less decided, and they possess more harmony and softness. We think that it is a real acquisition for those who seek the effects of art in the results of photography.

White of egg, to which have been added thirty drops of a saturated solution of iodide of potassium, and two drops of a saturated solution of bromide of potassium to each white of egg, is beaten up to a snow. It is left to repose until the snow returns to albumen in the liquid state, and then filtered through silk or clear muslin, the albumen being collected in a large and quite flat vessel. The paper to be prepared is then deposited on the layer and left on it for a few minutes. When it is covered with albumen, it is raised by one of its corners, and allowed to drain and dry by suspending it by one or two corners from a line.

The preparation with the aceto-nitrate is, in every respect, the same as that described for the paper prepared with serum; care must be taken to dry it between two folds of blotting paper only when the paper has acquired complete transparency. It is put into the frame for exposure in the same manner, the appearance of the image and the rest of the operation is the same; but the exposure requires a longer time, generally four or five minutes.

Preparation of the Positive Albumen Paper.—The positive paper prepared with albumen gives somewhat less brilliant proofs, but of a richer tone, and of a more agreeable finish and transparency; it is prepared in the following manner:—

To the whites of eggs is added 25 per cent. (by weight) of water saturated with chloride of sodium. The white of egg is beaten into a snow, and filtered as in the preceding preparation, only in this case the paper is left on the albumen for only half a minute. It is then hung up to dry, which is accomplished in six or eight minutes; it is afterwards deposited in a vessel containing 25 parts of nitrate of silver, and 100 parts of distilled water. The paper is left in the bath at least six minutes, and afterwards dried flat.

ON IMAGES OF THE SUN AND MOON OBTAINED ON GLASS BY PHOTOGRAPHY.*
BY M. NIEPCE DE SAINT-VICTOR.

Having lately heard M. Arago state at the Academy, that proofs of the sun had been taken on plates of silver, I wished to see the effect produced on a sheet of glass covered with a layer of coagulated albumen, which, as is known, gives an inverse or negative proof.

I operated in the following manner:— Having prepared my glass plate, without employing any means of acceleration, I exposed it in the camera-obscura, of which the object glass (I operated with an object glass for a fourth of the plate) was in the direction of the sun, the image of which I had placed in the visual focus, which in this object glass corresponds exactly to the photogenic focus.

My first experiments were made as quickly as possible, that is to say, as quickly as I could uncover and cover the object glass, operating with a diaphragm of five millimetres in diameter. Notwithstanding this, the image came too rapidly. On submitting the plate to the action of gallic acid, it became quite black. I then conceived the idea of raising the diaphragm and leaving the object glass uncovered long enough for the image to appear without the aid of gallic acid, and this succeeded.

The first plate was exposed five, and the second ten seconds.

These were the results I obtained:— the first plate showed a very visible and distinct image, of a blood-red color, much deeper in the middle than at the edges, as any one may see by examining the plate.

The second plate presented the same difference between the centre and the circumference, but with greater intensity; besides which, it had a circle beyond the image, in the form of a glory.

The different intensity of the centre and the edge is so much the greater as, notwithstanding the effect of contrast, it is still very perceptible, especially when examined by the microscope. And by the same effect of contrast, if the image is blackened with gallic acid, the reverse effect takes place.

I have made more than twenty proofs, and almost always with the same results.

The results of these experiments are quite in conformity with the opinion announced by M. Arago, that the photogenic rays emanating from the centre of the Sun have more action than those near the edge or circumference.

I tried, and with success, to take the image of the Moon in twenty seconds, the Moon being at the full, and perfectly in the focus of my object glass; and without using an heliostat, I obtained a very round image. But the rapidity with which I operated was so great, that the Moon had not time to move perceptibly; for I should say, that if left for thirty seconds we should have rather an oval image.

To obtain an image of the moon, I found it necessary to operate in the speediest manner, such as would enable me to take a proof of a landscape illumined by diffused light in one, or at most two, seconds.

I obtained this great rapidity by new means, which I have lately consigned to the Academy in a sealed packet. This packet likewise contains a means analogous to that which M. Blanquart has just published for operating in the dry way on paper; I likewise explain the way to prepare paper with albumen for positive proofs. I propose to make these processes known when I have concluded the works with which I am at this moment occupied.

CHEMISTRY APPLIED TO ARTS AND
MANUFACTURES.

On a Method of fixing Colors upon Tissues. By C. BROQUETTE.

When an egg is boiled in a color-bath, the color immediately fixes itself to the shell. Egg-shells contain, like bones, an organic tissue and mineral salts. If it is attempted to dye these mineral salts—the phosphate or carbonate of lime—separately, it fails, and therefore neither of these salts can be regarded as the mordant. If, on the contrary, it is attempted to color the organic tissue of egg-shells or of bones, this immediately becomes dyed; hence it follows that the

* *Comptes Rendus*, No. 22, June 3, 1850.

organic matter of the bones and eggshells is the mordant.

Now in the same manner as mineral mordants have hitherto been employed to fix coloring matters upon cotton, organic mordants may be used, and Broquette has already employed caseine for this purpose. The coating of vegetable fibres with animal substances was first carried out by M. Hausmann, but is said never to have attained to any importance. The caseine must, of course, be first dissolved, in order that the tissues may be permeated by the solution, but it must then be rendered insoluble in the tissues. Now it has been shown by Braconnet, that caseine furnishes a soluble compound with ammonia, which is again decomposed by boiling. Broquette, therefore, impregnates the goods with a solution of caseine in ammonia, then heats them to expel the ammonia, upon which the caseine remains in an insoluble state in the tissues.

Cotton goods, after this treatment, are saturated with animal matter, and may now be dyed in the same color-baths as those used for woollen tissues.

Frequently the dyes are alkaline; they then dissolve the caseine, instead of being fixed by it. But since Bachelier used as a cement a mixture of lime and caseine, it is known that this mixture hardens and becomes fixed. Broquette therefore employs the caseine sometimes with lime alone, sometimes with ammonia and lime together, and saturates the goods with this caseate of lime, which soon sets in a warm atmosphere, and then resists the alkalies and rinsing with alkaline liquids.

By this treatment, the cotton acquires a peculiar stiffness; so that although its capacity for dyes has become nearly equal to that of wool, it is far behind the latter, owing to want of lustre. But this evil can also be remedied by mixing the mordant with oil. Oil, caseine and lime form a mordant which fixes the colors with a perfectly remarkable lustre.

When the goods to be dyed consist of wool and cotton, a different plan has to be followed; the mordant in this case is not adapted for the two materials; the wool is deprived of its natural lustre, and the cotton tissues are not sufficiently penetrated. For such goods Broquette employs the mordant before the weaving; it is applied to the cotton in the spinning,

when it can afterwards be woven and bleached like wool, without the mordant experiencing any injury. When threads thus prepared are woven, the tissues can be dyed just like woollen stuffs without further treatment.

By means of the solution of caseate of lime, mineral colors which are insoluble in water can be adapted to the dyeing of stuffs; they are mixed in a state of very fine powder with the solution. These liquid colors, which can be prepared for instance with ultramarine, ochre, &c., can again be removed with water, unless they have been dried; but as soon as they coagulate, they adhere firmly to the tissues inclosing the coloring principle.

A further application of the mordant of caseine, oil and lime, is in the printing of stuffs; in this case we are not limited merely to mineral colors, which by its aid may be fixed upon the goods, but the numerous vegetable colors may be likewise very well applied, by first converting them into lakes by means of alumina or protoxide of tin, and then using these lakes in the same manner as the powdered mineral colors. After being printed, the goods are wrapped in moist linen, and left for about half an hour in the moist vapor in a warm atmosphere. During this time, the impressed color does not dry superficially, but is absorbed into the interior of the fibres, and is then completely fixed in the subsequent drying.

This new method of mordanting has already had considerable influence upon several pigments, for instance upon archil, which has only been used for dyeing exceptionally; according to Broquette's process, some very beautiful colors are obtained from it, modifications of the peculiar color of the archil by lime.

It will be evident, from what has been above stated, that in this process of dyeing, it is requisite to pass the goods through a lime-bath, which will not do for many dyes, as the colors have their tints altered by such treatment. In such cases, magnesia is to be substituted for the lime.

When goods are printed with the mineral colors or lakes, according to the above process, very full colors are obtained, which, in the case of many patterns is not desirable. To bring out the shades and half-colors in the full-colored impressions,

the printed goods are placed with their colored surface upon an absorbing ground, cotton stuff, and the forms pressed on the back. The printed portion pressed upon the absorbing surface is deprived of some of its color, and numerous patterns can be produced in this manner.—*Journ. de Chim. et de Pharm.*, xvii. p. 271.

THE TEREDO NAVALIS.

From the London Mechanics' Magazine.

The Tereido Navalis has been examined by chemists, and traces of vegetable matter have been found in its intestines. Physiologists have also detected woody fibre by means of the microscope; so there is no doubt that it lives by gnawing and eating the timber; its ravages when it has once entered a pile are exceedingly rapid, and never stop till it has been so bored through, as to be totally useless; and this it has accomplished in a few months. It is classed by physiologists at the zero of cold-blooded animals; and as the coldest-blooded animals are the most tenacious of life, the drug which would be sufficient to kill a human being, or even a frog, would have little or no effect upon it. It therefore seems that the most virulent poison is necessary to affect the sense or cause the death of this little, but formerly mighty obstacle to engineering skill.

Pitch, tar, sulphur, and nearly all chemical matters which are known to be obnoxious to animals, or to destroy life, have been tried; but have all failed. This is to be attributed to one of two reasons—either that the salt-water negatives the poison, or that the poison does not personally affect the worm; besides, the sea contains so many different chemical ingredients, according to the rocks, salts, and vegetable matters which may exist at any particular spots, so that those chemicals which might possibly answer well at Woolwich or Plymouth, might be entirely nullified at Calcutta or Sidney, and *vice versa*.

Mechanical means have also been used; copper sheathing was tried, but the tereido entered between the joints, and it would be almost impracticable (even putting the expense aside) to lay the plates so closely as to prevent their entrance; besides, a blow or strain would cause the joints to give at once. Broad-

headed nails have also been tried, and they succeeded; for although they were not driven closely together, the salt-water and iron formed an impenetrable coat of rust to the insect: but this would not do on a large scale, for if the rust were rubbed off from any cause, or one or two nails were not exactly in their places, the pile would be destroyed.

Paine's process consists in soaking the timber first in one solution and then in another; the two solutions having penetrated between the fibres and into the interstices, form a hard and impervious crystallized mass. The total failure of Paine's process, at Fleetwood, is to be attributed to the fact, that the contractor's time having nearly expired, the piles were driven in too soon after saturation: some of them were actually warm; and consequently, before the watery matter had time to evaporate and allow the crystallization to take place, the rush of the tide washed the particles held in solution away.

Creosote or oil of tar has been, and is almost universally, used by engineers and builders for the preservation of the timber piles and supports of bridges and piers, and for railway sleepers. It is obvious that great care must be taken that every crack or crevice in the surface of the wood is thoroughly saturated, and, in order that no part may escape saturation, the following plan is adopted:—One gallon of oil of tar is necessary per cubic foot for bridges and piers; the pressure employed to force it into the pores of the wood is about 150 lbs. to the square inch; each pile is weighed before it goes into the tank, and if when it comes out its weight has not increased 10 lbs. per cubic foot, it is put back into the tank again. The cost of saturation is as near as possible 6d. per cubic foot; the saturation for railway sleepers is a little less—about 8 lbs. of oil of tar, and 5d. the cost per cubic foot. The timber should of course be saturated according to the amount of wear and tear it is likely to suffer—generally from 2 to 3 inches deep is sufficient; as far as the tereido is concerned, they would not attempt to bore if there were only a thin outside coating put on; but the saturation of 2 or 3 inches deep is necessary, in case of any place being rubbed or chipped off.

Several specimens of timber said to

have been saturated with creosote, but perforated by the worm, have been brought from different places; but on full inquiries being made, and on examining the piles from which they were cut, it appeared that in one case a piece had been sawn from a pile several inches thick for the purpose of fixing a stay, and of course, the heart of the pile being exposed, the teredo entered some time after the sample was cut; while in not a few cases the specimens have been cut from guide piles accidentally left, and which of course were never saturated.

The only drawback to using this solution for railway bridges is its highly inflammable nature. The burning of the bridge over the Usk will be fresh in the memory of most of your readers; this was impregnated with oil of tar, and some workmen boring holes with red-hot irons, the bridge took fire, and so rapid was its progress, that before any assistance could be obtained, the whole bridge was in flames from one end to the other, and was ultimately burnt down. From the fact that this was a total loss to an insurance office in London, and also that they have no data or experience in this kind of risk to enable them to fix a percentage, many of the offices refuse to insure railway bridges impregnated with the same stuff as the Usk one, at any price. Whether this can be considered of any vital importance or not, engineers are thoroughly aware now, that timber properly impregnated with oil of tar is quite impervious to the borings of the teredo navalis, for in no one instance has it failed, but, on the contrary, when piles impregnated with other solutions have been completely eaten away, the piles impregnated with the oil of tar driven alongside have been examined, and found to be as free from the teredo navalis as when first put down.

ON GALVANIC SOLDERING.

In the 'Technologist' M. Elsner gives an account of some experiments he has made on galvanic soldering. Under the name of galvanic soldering, a process is known by means of which two pieces of metal may be united by means of another metal, which is precipitated thereon through the agency of a galvanic current. This mode of soldering by the "wet

method" has been often recommended in various periodicals relating to the industrial arts; but it has been objected that—practically speaking—the union between two pieces of metal could not be effected by means of a metal so precipitated by galvanic agency. In order, however, to arrive at a definite conclusion upon this question, M. Elsner undertook the following experiments, making use of a Daniell's "constant battery." The first experiment he made was by placing upon the end of the copper wire, which formed the negative electrode, a strong ring of sheet copper, cut asunder at one point, the distance between the severed parts being about one-half or one-third of a millimetre, and immersing it in a bath of sulphate of copper. At the end of a few days (during which time the exciting liquors were several times renewed) the space in the severed portion of the ring was completely filled up with copper regulus, which had been precipitated; and on partially cutting with a file through the part thus filled up, and examining it with a lens, it was observed to be very equally filled with solid and coherent copper. A second experiment was made with another copper ring cut into two parts, and the two segments placed with the faces of the sections opposite each other, and similarly submitted to the action of a galvanic current. At the end of a few days the segments were united by the copper precipitated, and again formed a complete ring. A third experiment was made by placing two strong rings of sheet-copper, with their freshly cut faces upon one another, so that the two rings constituted a cylinder. These rings were surrounded by a band of sheet-tin coated with a solution of wax, so that the two rings were equally surrounded by a conducting material. The rings were then attached to the negative wire of the battery, and immersed in a bath of sulphate of copper. At the end of a few days the interior surface and the contact surfaces of the two rings were covered with precipitated copper. The rings were only submitted to the galvanic current to such an extent as to cover their interior surface with a thin coating of precipitated copper, and yet they were so completely reunited that they formed a single cylinder. The exterior conduct-

ing covering of tin was, of course, removed, before testing the cohesion of the galvanic precipitate.

From these experiments, there appears to be no doubt that two pieces of metal may be firmly united or soldered by galvanic agency. It will, therefore, be possible to firmly unite the different parts of a large piece of metal, and to make a perfect figure of them by galvanic precipitation of a metal (copper in ordinary cases). If solutions of salts of gold or silver were employed in as concentrated a form as those of copper above mentioned, there is reason to believe that galvanic soldering would also result. In fact, M. de Hackewitz states, that in some experiments on a larger scale, which he undertook, to obtain hollow figures by galvano-plastic means, he had remarked that galvanic union often took place between the pieces operated upon. M. Elsner states, that while conducting the experiments above-mentioned, he remarked that, by employing too powerful a current, the negative electrodes of copper, and even the plate of copper, and ring of the same metal resting thereon, became covered with a deep brown substance, in the same manner as this occurs under similar circumstances in galvanic gilding, as is well known. After several unsuccessful attempts to prevent the formation of this brown coating, M. Elsner found that it was possible to remove it entirely on immersing the articles covered therewith, during a few seconds, in a mixture of sulphuric and nitric acids. By this means the precipitated copper was made to assume its natural red color.

With respect to the cohesion of the galvanic soldering, it is the same as that of copper or other metal precipitated by galvanic agency. It will, moreover, be well understood, that too energetic galvanic excitation must have an injurious influence upon the cohesion of the metal precipitated; and in this case precisely the same phenomena will be observed as those which have long manifested themselves in ordinary galvano-plastic operations.—*Architect and Engineers' Journal*.

EFFECT OF SHOT ON IRON VESSELS.

Two sections of new iron, each 10 feet square, were built similar to the *Simoon*

at the wales, as to plates, ribs, and security, with the exception of the occasional filling-in pieces of oak between the ribs on the main deck and the inside planking, and which would not have added to the safety of a vessel or crew. The plates were $\frac{1}{8}$ ths of an inch thick. These sections were placed 35 feet apart, and at a distance of 450 yards, secured to piles, driven firmly into the ground. A screen of 1-inch fir boards was placed 10 feet behind the front section, to test the severity of the splinters, and another of extended canvas, to ascertain their number. The guns and charges made use of were such as all the steam vessels carry.

The result of these experiments is the reverse of those made on the *Ruby*, in 1846, a small, light-built iron vessel, when the great damage was found to be sustained on the shot passing out on the opposite side to that fired at, making clear round holes only on the first side. On the present occasion, the resistance being so much greater, the principal injury has been on the front side; and the fractures made are of that description that two or three shot, and sometimes even a single one, striking under the water-line, must endanger the ship. There is also another most serious evil attending this great resistance, which was not anticipated, and which has caused great surprise. The shot or shell on striking are shivered into innumerable pieces, passing on as a cloud of langrage with great velocity, sufficient to pass through the 1-inch fir boards, the larger pieces going to a considerable distance (400 or 500 yards), and some through the rear section, making large irregular holes: this would be most destructive, and I firmly believe men could not stand behind it.

It will be observed that all description of shot, from the 10-inch down to grape, have been used, and all with similar destructive effect.

The last shot fired, an 8-inch with a 5 lbs. charge, established the point that the wood-work will not prevent the evils before stated; it struck a rib that fastened it to the pile of 14 inches; it cut away every thing, and made the effect worse.

These experiments, I consider, prove that whether iron vessels are of a slight

or substantial construction, iron is not a material calculated for ships of war.

(Signed) H. D. CHADS, Captain.

Excellent, June 21, 1850.

[*Ibid.*]

THE GUTTA PERCHA TRADE.

Previous to 1844, the very name of gutta percha was unknown to European commerce. In that year 2 cwt. of it were shipped experimentally from Singapore. The exportation of gutta percha from that port rose in 1845 to 169 piculs; (the picul is $133\frac{1}{3}$ lbs.); in 1846, to 5,364; in 1847, to 9,296; in the first seven months of 1848, to 6,768 piculs. In the first four and a half years of the trade, 21,598 piculs of gutta percha, valued at 274,190 dollars, were shipped at Singapore; the whole of which was sent to England, with the exception of 15 piculs to Mauritius, 470 to the continent of Europe, and 922 to the United States.

But this rapid growth of the new trade conveys only a faint idea of the commotion it created among the native inhabitants of the Indian Archipelago. The jungles of the Johore were the scene of the earliest gatherings, and they were soon ransacked in every direction by parties of Malays and Chinese, while the indigenous population gave themselves up to the search with a unanimity and zeal only to be equalled by that which made railway jobbers of every man, woman, and child in England about the same time. The Tamungong, with the usual policy of oriental governors, declared the precious gum a government monopoly. He appropriated the greater part of the profits, and still left the Malays enough to stimulate them to pursue the quest, and to gain from 100 to 400 per cent. for themselves on what they procured from the aborigines. The Tamungong, not satisfied with buying at his own price all that was collected by private enterprise, sent out numerous parties of from 10 to 100 persons, and employed whole tribes of hereditary serfs in the quest of gutta percha.

This organized body of gum-hunters spread itself like a cloud of locusts over the whole of Johore, peninsular and insular. They crossed the frontier into Iigna, but there the sultan was not long in discovering the new value that had

been conferred upon his jungles. He confiscated the greater part of what had been collected by the interlopers, and, in emulation of the Tamungong, declared gutta percha a royalty.

The knowledge of the article, stirring the avidity of gatherers, gradually spread from Singapore, northward as far as Pinang, southward along the east coast of Sumatra to Java, eastward to Borneo, where it was found at Bruné, Sarawak, and Pontianak on the west coast, at Ketí and Passir on the east. The imports of gutta percha into Singapore, from the 1st of January to the 12th of July, 1848, according to their geographical distribution, were:—From the Malay Peninsula, 593 piculs; from the Johore Archipelago, 1,269; from Sumatra, 1,066; from Batavia, 19; from Borneo, 55. The price at Singapore was originally 8 dollars per picul: it rose to 24, and fell about the middle of 1848 to 13.

The commotion among the human race in the Archipelago was great, but the vegetable kingdom suffered most by it. In the course of three and a half years 270,000 trees were destroyed.—*Mechanics' Magazine*, London.

THE REWARD OF GENIUS.

From the Mining Journal.

We have all heard that a Harvey lost his practice through discovering and promulgating that the blood circulated in the body—that the Royal Society laughed at Franklin's discovery of the identity of lightning and pyrogen—that the Paris Academy of Sciences condemned Fulton's great invention—that it was pronounced that steam-vessels could not cross the Atlantic—and that Ericson's screw propeller was condemned in this country, with numerous other instances of a similar nature. But the following letter, from Miss Costello's *Summer among the Bocages and Vines*, tells the most lamentable story of the kind I ever met with:—

“*Paris, Feb. 1641.*

“MY DEAR EFFIAT,—While you are forgetting me at Narbonne, and giving yourself up to the pleasures of the Court, and the delight of thwarting M. le Cardinal de Richelieu, I, according to your desire, am doing the honors of Paris to your English lord, the Marquis of Worcester; and I carry him about,

or rather he carries me, from curiosity to curiosity, choosing always the most grave and serious, speaking very little, listening with extreme attention, and fixing on those whom he interrogates two large blue eyes, which seem to pierce to the very centre of their thoughts. He is remarkable for never being satisfied with any explanations which are given him; and he never sees things in the light in which they are shown him. You may judge of this by a visit we made together to Bicêtre, where he imagined he had discovered genius in a madman. If this madman had not been actually raving, I verily believe your marquis would have entreated his liberty, and have carried him off to London, in order to hear his extravagances from morning till night at his ease. We were crossing the court of the madhouse; and I, more dead than alive with fright, kept close to my companion's side, when a frightful face appeared behind some immense bars, and a hoarse voice exclaimed, 'I am not mad! I am not mad! I have made a discovery which would enrich the country that adopted it!' 'What has he discovered?' I asked of our guide. 'Oh, (he answered, shrugging his shoulders,) something trifling enough. You would never guess it; it is the use of the steam of boiling water.' I began to laugh. 'This man (continued the keeper) is named Solomon de Caus. He came from Normandy, four years ago, to present to the king a statement of the wonderful effects that might be produced from the invention. *To listen to him, you would imagine that with steam you could navigate ships, move carriages*—in fact, there is no end to the miracles which, he insists upon it, could be performed. The Cardinal sent the madman away without listening to him. Solomon de Caus, far from being discouraged, followed the Cardinal wherever he went with the most determined perseverance, who, tired of finding him for ever in his path, and annoyed to death with his *folly*, ordered him to be shut up in Bicêtre, where he has now been for three years and a half, and where, as you hear, he calls out to every visitor that he is not mad: but that he has made a valuable discovery. He has even written a book on the subject, which I have here.' Lord Worcester, who had listened to this account with much interest, after listening a time, asked for the book, of which, after having read several pages, he said—'This man is not mad. In my country, instead of shutting him up, he would have been rewarded. Take me to him, for I should like to ask him some questions.' He was accordingly conducted to his cell; but, after a time, he came back sad and thoughtful. 'He is indeed mad now (said

he), misfortune and captivity have alienated his reason; but it is you who have to answer for this madness; for, when you cast him into that cell, you confined the greatest genius of the age.' After this, we went away; and, since that time, he has done nothing but talk of Solomon de Caus.

"Adieu, my dear friend and faithful Henry. Make haste and come back; and pray do not be so happy where you are as not to keep a little love for me.

"MARION DELAMORE."

Poor de Caus! What interest would his book possess could it be recovered. The letter is also highly interesting in another point of view. It gives a fine description of a nobleman whose name stands prominent in the history of the steam-engine, and, at the same time, casts some degree of suspicion upon the originality of his inventions. It would be singular, indeed, if, on further investigation, it should be found that he got them from the unfortunate maniac of the Bicêtre.

JOHN J. LAKE.

ORDINANCE OFFICE, Portsmouth.

MR. STEPHENSON'S FIRST CELEBRATED
ENGINE, "THE ROCKET."

This engine was bought in the year 1837, from the Liverpool and Manchester Railway Company, by James Thompson, Esq., of Kirkhouse, the lessee of the Earl of Carlisle's coal and lime works. Here the engine was worked for five or six years on the Midgeholme Railway, a local line, belonging to Mr. Thompson, for forwarding his coals from the pits towards Carlisle. Soon after the engine was placed on the line, the great contest for East Cumberland took place, when Sir James Graham was superseded by Major Aglionby, and it was used for conveying the Alston express with the state of the poll from Midgeholme to Kirkhouse. Upon that occasion, the *Rocket* was driven by Mr. Mark Thompson, and accomplished its share of the work, a distance of upwards of 4 miles, in $4\frac{1}{2}$ minutes, thus reaching a speed nearly equal to 60 miles an hour. On the introduction of heavier and more powerful engines, the *Rocket* was "laid up in ordinary," in the yard at Kirkhouse, where it now stands, a monument of the genius of the inventor.

Such an engine, the first constructed on the principle which has brought railways to such a height of perfection in this country, and throughout the world, ought to have its abiding place in the British Museum, as one of the greatest, if not the very greatest, invention of modern times; and we trust measures may be taken for accomplishing this object.—*Carlisle Journal*.

REVIEWS.

Report of Commissioners appointed by command of her Majesty to inquire into the Application of Iron to Railway Structures. (Presented to both Houses of Parliament. 1849.)

Iron applied to Railway Structures. By G. D. DEMPSAY. 1850.

In the present "iron age," every thing professing to treat of "the material" is of more or less interest; and the work before us is peculiarly so, from the character of the individuals making the experiments, the scale upon which they were conducted, the nature of the results obtained, and their bearing upon the every-day operations of all classes of mechanics in our midst.

We shall copy freely from the Report and experiments, as of undoubted reliability, and possessing great value to the majority of our readers.

The accident at Chester—the failure of a cast-iron girder bridge—it will be remembered, created some excitement in England, and there resulted an outcry against the use of iron in railway structures; this led ultimately to the appointment of a commission to inquire into its application for such purposes; and the result is before us.

One of the earliest examples of this form of bridge was erected in 1840, to carry the Northern and Eastern Railway over the Lea river, in England, and consisted of two parallel girders, level from end to end, placed at such distances apart that the railway is carried between them. Each girder consisted of two castings, joined together with a vertical joint at the middle of the length, the clear span being 66 feet, bearing

on the wall at each end 2 feet—total length of girder, 70 feet—length of each casting, 35 feet. These girders were 3 feet in depth, and each of them was trussed with 2 sets of malleable iron bars, one set being fixed on each side of the girder, and consisting of two rows of bars 6 inches wide and 1 inch in thickness. At points about 22 feet from either end of the girder, saddles were fixed below the bottom flange, and at each end of the girder, bosses were cast upon it near the top flange. The malleable iron bars were keyed through these bosses, and, descending obliquely, were secured to the saddles by means of turned wrought iron pins 3 inches in diameter. Between the saddles, horizontal bars were passed along under the middle portion of the girder, 22 feet in length, and thus completed the trussing. In bridges of this kind, the rails are carried upon transverse timbers or girders, which are supported in pockets cast upon the inner side of each main girder, either actually upon, or a little above, the lower flange of it.

The Dee bridge was of this description, in spans of 98 feet, on the same road with the famous tubular bridge, and built by the same engineer. The form of the girders was that of the common railway bars, known as the **I** or **I** rail; the vertical "web" being $2\frac{1}{8}$ inches thick, by about $3\frac{1}{2}$ feet deep; the lower flange, $24\frac{1}{2}$ inches wide by $2\frac{1}{2}$ thick, and the top flange, about $7\frac{1}{2}$ inches wide, by a little less than 2 inches thick; the whole cross section containing 160 square inches, and the whole depth being 45 inches.

In addition to this, wrought-iron suspension bars, containing 60 square inches of cross section, running obliquely downwards from a connection at the ends, about 3 feet above the upper flange (there being a rising portion at the ends to which such connection is made), to the lower flange, at the joints of the cast-iron part, 36 feet, or one-third the length of the girder, from the ends; the casting being in three pieces, connected by bolting through flanges, and by strengthening pieces at the joints. Between

the two joints, the suspension bars run horizontally, just above the lower flange of the girder.

One effect of these suspension bars is, to throw a great strain upon the top flange, insomuch that the engineers who examined and testified upon the subject, upon the inquest held in relation to the lives lost by the accident, *generally* concurred in the opinion that they rather weakened than strengthened the girder.

By calculation according to formulæ deduced from experiment, a pair of these girders is estimated to be able to sustain at the extreme or breaking point, 148 tons in the centre, or 296 tons distributed uniformly over their length. In this estimate, the testifying engineers concur with little or no variation. Now, the weight of a pair of girders is about 70 tons, or, with other parts of the structure, about 90 tons. Mr. H. Robertson (engineer) estimates the effects of the engine and tender as "equivalent to 32 tons in the centre," which is equal to 64 tons distributed. Add to these, "25 tons of ballast," which was put on to the bridge just before the accident, and we see there was $90 + 64 + 25 = 179$ tons upon the bridge, which was more than six-tenths of the actual breaking weight, supposing it all at rest, and acting equally on the two girders. But the action of the engine, and the vibration of the girders (which must be considerable for a length between supports equal to about 26 times the depth), must be very important. It is therefore not improbable, that the girder was taxed more than two-thirds of its extreme capacity under favorable circumstances.

Now, from one-quarter to one-third of the actual breaking strain, is all that engineers estimate it safe to rely on cast-iron to bear; whereas, in case of the Dee bridge, it was exposed to a load of more than six-tenths of the ordinary capacity, besides the effects of motion, vibration, &c. It certainly cannot be surprising, then, that a failure took place.

We see that the Dee bridge contained some 70 tons or more of iron in the girders,

for a single track of 98 feet stretch, besides 20 tons in the other work, which is nearly one-third of the actual breaking weight of the girders.

The failure of the "Rider" iron bridge at Buffalo, some time since, and, again, the failure of the same plan of bridge on the New-York and Erie Railroad, as well as numerous failures of girders in buildings, show pretty conclusively that more *light* is wanted upon this subject of the use of iron in structures intended to bear heavy weights.

THE COMMISSIONERS' REPORT.

The leading points of the Report may be classed under the following heads:—

1. *Present rules for proportioning the load of girders to their breaking weights.*

"The dimensions of cast-iron girders intended for sustaining stationary loads, such as water-tanks and floors, are usually so proportioned that their breaking weight shall be *three times* as great as the load they are expected to carry, or in some cases *four or five times* as great. But when the girders are intended for railway bridges, and therefore subject to much concussion and vibration, greater strength is given to them by altering the above proportions, and making the breaking weight *from six to ten times* as great as the load, according to the practice of different engineers. On the other hand, some consider that *one-third* of the breaking weight is as safe a load in the latter case as in the former.*

2. *Nature of former experiments, and of those now required, and questions to be examined.*

"The proportions and forms at present employed for iron structures have been generally derived from numerous and careful experiments, made by subjecting bars of wrought or cast-iron of different forms to the action of weights, and thence determining

* The variation of the proportion of breaking weight to load adopted—viz., *from three times to ten times*, is truly a sufficient proof of the absence of well-established principles. Any "common-sense" and non-professional person, required to select between these two limits, would, in all probability, forego all further reasoning and experiment, by "striking the average," and to this identical result, or very near it, the scientific labors of the Commissioners will presently appear to have led them.

by theory and calculation such principles and rules as would enable these results to be extended and applied to such larger structures and loads as are required in practice. But the experiments were made by dead pressure, and only apply, therefore, to the action of weights at rest. On the contrary, from the nature of the railway system, the structures employed therein are necessarily exposed to concussions, vibrations, torsions, and momentary pressures of enormous magnitude, produced by the rapid and repeated passage of heavy trains. It soon appeared, in the course of the inquiry, that the effects of heavy bodies moving with great velocity upon structures, had never been made the subject of direct scientific investigation; and as it also appeared that, in the opinion of practical and scientific engineers, such an inquiry was highly desirable, the attention of the Commissioners was early directed to the devising of experiments for the purpose of elucidating this matter.*

The Commissioners accordingly proposed to examine the questions involved in the inquiry under the two following heads—viz.,

“1. Whether the substance of metal which has been exposed for a long period to percussions and vibrations undergoes any change in the arrangements of its particles by which it becomes weakened? And,

“2. What are the mechanical effects of percussions and the passage of heavy bodies in deflecting and fracturing the bars and beams upon which they are made to act?”

Upon the first of these questions the Commissioners cite observations and conjectures to the following effect:—

“Many curious facts elicited in evidence show, that pieces of wrought iron which have been exposed to vibration, such as the axles of railway carriages, the chains of cranes, &c., employed in raising heavy weights, frequently break after long use, and exhibit a peculiar crystalline fracture and loss of tenacity, which is considered by some engineers to be the result of a gradual change produced in the internal structure of the metal by the vibrations. In confirmation of this, various facts are adduced, as, for instance, that if a piece of good fibrous iron have the thread of a screw cut upon one end of it by the usual process of tapping, which is always accompanied by much vibratory action, and if the bar be then broken across, it will be found that the tapped part is a good deal more crystalline than the other portion of the bar. Others contend that this peculiar structure

is the result of an original fault in the process of manufacture, and deny this effect of vibration altogether; whilst some allege that the crystalline structure can be imparted to fibrous iron in various ways, as, by repeatedly heating a bar red-hot, and plunging it into cold water, or by continually hammering it, when cold, for half an hour or more. One witness* thinks the various appearances of the fracture depend much upon the mode in which the iron is broken. The same piece of iron may be made to exhibit a fibrous fracture when broken by a slow heavy blow, and a crystalline fracture when broken by a sharp short blow. Temperature alone has also a decided effect upon the fracture; iron broken in a cold state shows a more crystalline fracture than the same iron warmed a little. The same effects are by some supposed to be extended to cast iron.”

The Commissioners “endeavored to examine this question experimentally in various ways,” which they report as follows:—

“A bar of cast-iron, three inches square, was placed on supports about 14 feet asunder. A heavy ball was suspended by a wire 18 feet long from the roof, so as to touch the centre of the side of the bar. By drawing this ball out of the vertical position at right angles to the length of the bar, in the manner of a pendulum, to any required distance, and suddenly releasing it, it could be made to strike a horizontal blow upon the bar, the magnitude of which (i. e. the blow) could be adjusted at pleasure, either by varying the size of the ball or the distance from which it was released. Various bars (some of smaller size than the above) were subjected, by means of this apparatus, to successions of blows, numbering in most cases as many as 4000, the magnitude of the blow in each set of experiments being made greater or smaller as occasion required. The general result obtained was, that when the blow was powerful enough to bend the bars through *one-half* of their *ultimate deflection* (that is to say, the deflection which corresponds to their fracture by dead pressure), no bar was able to withstand 4000 such blows in succession; but all the bars (when sound) resisted the effects of 4000 blows, each bending them through *one-third* of their ultimate deflection.

“Other cast-iron bars, of similar dimensions, were subjected to the action of a revolving cam, driven by a steam-engine. By this they were quickly depressed in the centre, and allowed to restore themselves, the process being continued to the extent

* Brunel.

even, in some cases, of a hundred thousand successive periodic depressions for each bar, and at the rate of about four per minute. Another contrivance was tried, by which the whole bar was also during the depression thrown into a violent tremor. The results of these experiments were, that *when the depression was equal to one-third of the ultimate deflection, the bars were not weakened.* This was ascertained by breaking them in the usual manner with stationary loads in the centre. When, however, *the depressions produced by the machine were made equal to one-half of the ultimate deflection, the bars were actually broken by less than nine hundred depressions.* This result corresponds with and confirms the former.

"By other machinery, a weight equal to half of the breaking weight was slowly and continually dragged backwards and forwards from one end to the other of a bar of similar dimensions to the above. *A sound bar was not apparently weakened by ninety-six thousand transits of the weight.*"

From these observations, the Commissioners proceed to deduce as follows:—

"It may on the whole, therefore, be said, that as far as the effects of reiterated flexure are concerned, cast-iron beams should be so proportioned as scarcely to suffer a deflection of one-third of their ultimate deflection. And as it will presently appear that the deflection produced by a given load, if laid on the beam at rest, is liable to be considerably increased by the effect of percussion, as well as by motion imparted to the load, it follows, that *to allow the greatest load to be one-sixth of the breaking weight is hardly a sufficient limit for safety, even upon the supposition that the beam is perfectly sound.*"

The practical truth of the approximate rule thus derived will evidently depend, not only on the correctness of the experiments, which is not to be questioned, but also on the correspondence of the several conditions under which they were made, with those affecting the structures referred to; and since the application of the rule would impose a large increase of section in girders designed to support railway bridges, every item of the data upon which it is founded claims the scrutiny of the inquirer.

The Report proceeds to state, that

"In wrought-iron bars no very perceptible effect was produced by 10,000 successive deflections by means of a revolving cam, each deflection being due to half the weight

which, when applied statically, produced a large permanent flexure."

The mechanical effects of percussions and moving weights upon beams.

"To ascertain these effects a great number of experiments have been made by the Commissioners, and from these it appears that bars of cast-iron, of the same length and weight, struck horizontally by the same ball (by means of the apparatus before described for long-continued impact), *offer the same resistance to impact, whatever be the form of their transverse section, provided the sectional area be the same.* Thus, a bar, $6 \times 1\frac{1}{2}$ inches in section, placed on supports about 14 feet asunder, *required the same magnitude of blow to break it in the middle, whether it was struck on the broad side or the narrow one,* and similar blows were required to break a bar of the same length, the section of which was a square of three inches, and, therefore, of the same sectional area and weight as the first.*

"From another course of experiments made with the same apparatus, it appeared, among other results, that the deflections of wrought-iron bars were *nearly as the velocity of impact.*

"By another set of experiments, it was found that *beams of cast-iron, loaded to a certain degree with weights spread over their whole length, and so attached to them as not to prevent the flexure of the bar, resisted greater impacts from the same body falling on them, than when the beams were unloaded, in the ratio of two to one.*

"Another series of experiments were made to compare the mechanical effect produced by weights passing with more or less velocity over bridges, with their effect when placed at rest upon them. The general result thus obtained was, that the deflection produced by a load passing along a bar was greater than that produced by placing the same load at rest upon the middle of the bar, and that this deflection *was increased when the velocity was increased.* Thus, for example, when the experimental carriage, loaded to 1120 pounds, was placed at rest upon a pair of cast-iron bars, 9 feet long, 4 inches broad, and an inch and a half deep, it produced a deflection of six-tenths of an inch; but when the carriage was caused to pass over the bars at the rate of ten miles an hour, the deflection was increased to eight-tenths, and continued to increase as the velocity was increased, so that, at thirty miles

* These startling results, which seem to belie all previously held principles upon the subject, cannot fail to arrest the attention of the inquirer.

per hour, the deflection became an inch and a half; that is, more than double the statical deflection.

"Since the velocity so greatly increases the effect of a given load in deflecting the bars, it follows that a much less load will break the bar when it passes over it, than when it is placed at rest upon it, and accordingly, in the example above selected, a weight of 4150 pounds is required to break the bars if applied at rest upon their centres; but a weight of 1778 pounds is sufficient to produce fracture if passed over them at the rate of 30 miles an hour.

"It also appeared that when motion was given to the load, the points of greatest deflection, and, still more, of the greatest strains, did not remain in the centre of the bars, but were removed nearer to the remote extremity of the bar. The bars, when broken by a travelling load, were always fractured at points *beyond their centres*, and often broken into four or five pieces, thus indicating the great and unusual strains they had been subjected to."

The Commissioners endeavored to discover the laws which connect these results with each other and with practice, and for this purpose a small and delicate apparatus was constructed to examine the phenomena in their simplest form—viz.,

"In the case of a single weight traversing a light elastic bar; for the weight, in its passage along the bar, deflects it, and thus the path, or *trajectory* of the centre of the weight, instead of being a horizontal straight line, as it would be if the bar were perfectly rigid, becomes a curve, the form of which depends upon the relation between the length, elasticity, and inertia of the bar, the magnitude of the weight, and the velocity imparted to it. If the form of this curve could be perfectly determined in all cases, the effects of travelling loads upon bars would be known; but unfortunately the problem in question is so intricate, that its complete mathematical solution appears to be beyond the present powers of analysis, except in the simplest and most elementary case—viz., that in which the load is so arranged as to press upon the bar with one point of contact only, or, in other words, the load is considered as a heavy moving point. In practice, on the contrary, a single four-wheeled carriage touches each rail or girder in two points, and a six-wheeled engine with its tender has five or six points in contact on each side. This greatly complicates the problem.

"The small apparatus here referred to, is

so arranged as to comply with the simple condition, that the load shall press upon one point only of the bar, and is also furnished with a contrivance by which the effects of various proportions of the mass of the bar to that of the load can be examined. From the nature of the problem, it is convenient to consider, in the first place, the forms of the trajectories that are described, and the corresponding deflections of the bar, when the mass of the bar is exceedingly small compared with that of the load. Having obtained these, under different relations of the length of the bridge, its statical deflection, and the velocity of the passing load, the Commissioners desired to investigate, in addition, the effect which a greater proportional mass of the bar or bridge has upon the deflections. In order to produce appreciable deflections in the experiments, the ratio of the load to the inertia of the bearing bar was necessarily far greater than any that actually occurs in the loading of railway bridges, and in these enforced conditions of the experiments, and the subsequent reduction of the results, we have two possible sources of errors that may seriously invalidate the character of the theory. This difficulty is candidly stated by the Commissioners, in whose experiments the weight of the load was from three to ten times that of the bar: whereas, in actual bridges of about 40 feet span, the weight of the engine and tender is very nearly the same as the weight of that half of the bridge over which it passes, and in large bridges the weight of the load is much less than that of the bridge. The Commissioners consider that their experiments have established the fact, that an increase of velocity given to any given load causes an increase in the deflection of the supporting girder; and further, that the ratio of this increase of deflection to the statical deflection* of the girder, diminishes, while the length of the girder is increased.

"It became, therefore, necessary to investigate the laws of these phenomena; and to carry on also experiments directed to the express object of elucidating the theory, and tracing its connection with practice. It has been shown that the phenomena in question exhibit themselves in a highly developed state when the apparatus is on a small scale, but that, *on the contrary, with the large dimensions of real bridges, their effects are so greatly diminished as to be comparatively of little importance, except in the cases of short and weak bridges traversed with excessive velocities.* The theoretical and experimental

* By "statical deflection," is meant "that which would be produced by the load set at rest on the centre of the bridge."

investigation will, however imperfect, serve to show that such a diminution of effect, in passing from the small scale to the large, is completely accounted for."

To be continued.

History of Propellers and Steam Navigation. By ROBERT MACFARLANE, C. E. (New-York: G. P. Putnam. 1851.)

This will be found a useful little book, and without doubt a correct sketch of the history of steam navigation. The successive steps from the original paddles to the various wheels and propellers now or lately in use, are exhibited with the aid of illustrations.

We could wish the style of the latter more worthy the research and aim of the author, which is less for the purpose of furnishing a minute history, than to benefit inventors and others, who, ignorant of what has been done in this line, are continually reinventing what has been already tried, and found inefficient.

Next to perpetual motion, there is no field in which ignorance has struggled more manfully to subvert the laws of matter, than in this of steam navigation. A moiety of the time consumed in devising new forms, if expended in investigating the principles of those already in use, would confer incalculably more benefit on the individual and upon society.

A more extended work on the subject is needed, to which we trust this will prepare the way.

PATENTS.

American Patents.

We purpose, under this head, to give, besides a list of the patents issued during the month previous, an exhibit of the claim embodied in the specification of such patents as promise to be of general interest. This will commence with the patents issued 1st January, 1851, and be continued monthly.

List of English Patents issued during the Month, from Sept. 28 to Oct. 24, 1850.

James Hamilton, of London, engineer, for improvements in machinery for sawing, boring, and shaping wood. September 23; six months.

Charles Harratt, of Royal Exchange-buildings, London, merchant, for improvements in rolling iron. September 28; six months.

Joseph Burch, of Craig Works, Chester, printer, for improvements in printing terry and pile carpets, woollen, silk, and other materials. September 23; six months.

Joseph Crossley, of Halifax, carpet-manufacturer; George Collier, of the same place, mechanic; and James Hudson, of Littleborough, printer, for improvements in printing yarns for, and in weaving carpets and other fabrics. September 28; six months.

Cyprien Theodore Tissereau, of Paris, France, gentleman, for certain improvements in hydraulic clocks. October 3; six months.

Jean Pierre Paul Amberger, of Paris, France, civil engineer, for certain improvements in the application of magnetic power for moving and stopping carriages, for giving adherence to wheels upon rails, and also for transmitting motion. October 3; six months.

William Tudor Mabley, of Manchester, patent agent, for certain improvements in the manufacture of soap. (Being a communication.) October 3; six months.

William Boggott, of St. Martin's-lane, Middlesex, gentleman, and William Smith, of Margaret-street, in the said county, engineer, for improvements in producing and applying heat, and in engines to be worked by steam or other elastic fluid, which engines are also applicable as pumps. October 3; six months.

Julian Bernard, of Buchanan-street, Glasgow, artist, for improvements in pneumatic springs, buffers, pumps, and stuffing-boxes. October 3; six months.

Charles Bury, of Salford, Lancaster, manager, for certain improvements in machinery or apparatus for preparing and spinning, doubling or twisting silk waste, cotton, wool, flax, or other fibrous substances. October 10; six months.

Charles Bury, of Salford, Lancaster, manager, for certain improvements in machinery or apparatus for cleaning, spinning, doubling, and throwing raw silk. October 10; six months.

Robert Beart, of Godmanchester, for improvements in the manufacture of bricks and tiles. October 10; six months.

John Scott Russell, of Great George-street, Westminster, engineer, for improvements in the construction of ships or vessels propelled by paddle-wheels, with a view to better arming the same. October 10; six months.

William Wood, of Over Darwin, Lancashire, carpet manufacturer, for improvements in the manufacture of carpets and other fabrics. October 10; six months.

William Francis Fernihough, of London, engineer, for improvements in locomotive and other steam engines, and improvements in obtaining motive power. October 10; six months.

Whiting Hayden, of Windham, Connecticut, United States of America, for an improved regulator or apparatus for regulating the draught of the sliver on the machine, termed the "drawing frame." October 10; six months.

Ardolf Frederick Gurlt, of Manchester, gentleman, for an improved method of extracting silver from argentiferous minerals. October 10; six months.

William Henry Ritchie, of Kennington, Surrey, gentleman, for certain improvements in machinery, for preparing and carding fibrous substances. (Being a communication.) October 10; six months.

William Edward Newton, of Chancery-lane, engineer, for improvements in manufacturing yarns. (Being a communication.) October 10, six months.

James Hamilton Browne, of the Reform Club, Pall Mall, Esq., for improvements in the separation and disinfection of fecal matters, and in the apparatus employed therein. (Being a communication.) October 10; six months.

George Michiels, of London, gent., for improvements in treating and preparing potatoes for seed. (Being a communication.) October 17; six months.

John Fowler, junr., of Melksham, Wilts, engineer,

for improvements in steam engines in raising and forcing fluids in irrigating and draining land, and in machinery for cutting wood for drain pipes and other uses. October 17; six months.

Daniel Trowers Shears, of Bankside, Surrey, copper merchant, for improvements in the manufacture and refining of sugar. (Being a communication.) October 17; six months.

John Robert Johnson, of Crawford-street, chemist, for improvements in fixing colors on fabrics made of cotton and other fibre. (Being a communication.) October 17; six months.

James Henry Baddeley, of Shelton, Stafford, engineer and designer, for improvements in the manufacture of ornamental articles of earthenware. October 17; six months.

Thomas Richards Harding, of Lille, France, manufacturer, for improvements in machinery for heckling and carding flax in machinery, for combing and drawing wool and other fibrous materials, and in machinery for making parts of such machines, and for a new arrangement of the steam engine for driving flax and woollen mills, which arrangement is also applicable to other purposes where motive power is required. October 17; six months.

Henry Bernoulli Barlow, of Manchester, consulting engineer, for improvements in spinning cotton and other fibrous materials. October 17; six months.

James Henry Williams, of Birmingham, manufacturer, for certain improvements in the manufacture of buttons. October 17; six months.

James Young, of Manchester, manufacturing chemist, for improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom. October 17; six months.

Jean Louis Pascal, of Moorgate-street, London, civil engineer, for an approved apparatus for the cure or prevention of smoky chimneys, and also for the ventilation of ships, rooms, and buildings in general. October 24; six months.

Thomas Beale Browne, of Hampen, near Ando-

versford, Gloucester, gentleman, for improvements in weaving and preparing fibrous materials, and staining or printing fabrics. (Being a communication.) October 24; six months.

Alexander Dixon, of Abercorn Foundry, Paisley, for improvements in moulding iron and other metals. October 24; six months.

John Mercer, of Oakenshaw, within Clayton-le-Moors, Lancashire, gentleman, for improvements in the preparation of cotton and other fabrics and fibrous materials. October 24; six months.

John Oliver York, of Boulogne-sur-Mer, France, for improvements in the mode or manner of generating steam in locomotive, marine, and other boilers. October 24; six months.

John Grant, of Hyde Park-street, Middlesex, for improvements in heating and regulating temperature. October 24; six months.

Aaron Rose, of Halesowen, Worcester, manufacturer, for a certain new and improved method or certain new or improved methods of manufacturing twisted gun and pistol barrels. October 24; six months.

Samuel Jacobs, of Highgate, Kendall, Westmoreland, cabinet-maker, for certain improvements in printing on woollen, cotton, paper, and other substances, parts of which improvements are applicable also to the purposes of coloring, shading, tinting, or varnishing such substances. October 24; six months.

Bryan Millington, of Brant Broughton, Lincoln, and of the firm of Millington and Sons, of Newark-upon-Trent, Nottingham, millers, for improvements in corn-cleaning and flour-dressing machines. October 24; six months.

Edward Clarence Shepard, of Parliament-street, Westminster, gentleman, for certain improvements in electro-magnetic apparatus, suitable for the production of motive power, of heat, and of light. (Being a communication.) October 24; six months. —*London Mechanics' Magazine.*

List of Articles of utility registered in England for the Month, extending from Sept. 26 to Oct. 23, 1850.

<i>Date of Regis-</i>	<i>No. in the Re-</i>	<i>Proprietors' Names.</i>	<i>Addresses.</i>	<i>Subjects of Design.</i>
<i>tration.</i>	<i>gister.</i>			
Sept. 26	2454	Joseph Morris & Sons	Astwood, Redditch	Needle-case.
" 28	2455	Hurst and Reynolds	Birmingham	Improved fastening for stays, and other articles of dress.
Oct. 1	2456	Thomas Thompson	Commander, Royal Navy	Safety-plug for boats and vessels.
" 4	2457	George Aldred	Primrose-street, Bishopsgate	Plate mortice nut for a looking-glass.
" 6	2458	Walter Raymond	Dalston	Life raft.
" 8	2459	Frederick Clowes	Birmingham	Self-adjusting vertebral brace.
" 10	2460	Samuel Augustus Hayes	Strand	Apparatus for fractures of the lower extremities.
" 12	2461	Thomas Key	Charing-cross	Regimental cased clarinet.
" 14	2462	Clayton Shuttleworth & Co.	Stamp End Works, Lincoln	Combined threshing, shaking, and riddling machine.
" 16	2463	H. Kilby and W. Harris	Cheltenham	Portable hot-house.
" 18	2464	John George Taylor	Great St. Thomas Apostle	Self-securing spring for pins, brooches, and ornaments.
" 20	2465	Allen and Moore	Birmingham	Match-box lid
" 22	2466	Mortiboy & Herbert	Newman-street	Clasp-fastener for bracelets, chains, and other articles of jewelry and dress.
" 24	2467	John Cartwright	Newton-wood, Chester	Steam-boiler.
" 26	2468	George Harrows	Old Bond-street	Railway travelling-trunk — "The Panelasticon."
" 28	2469	George Boulton	Great Dover-street	Safety pin.
" 30	2470	Roger Brown	Sheffield	Magnetic lightning conductor.
" 31	2471	Elkington & Co.	Birmingham	Fountain.
" 32	2472	W. Culverwell	Charlotte-street, Blackfriars-road	Portable doestic vapor bath.
" 33	2473	Fox, Henderson & Co.	Birmingham; and Spring Gardens, London	Luffer for a ventilator.

<i>Date of Regis- tration.</i>	<i>No. in the gister.</i>	<i>Proprietors' Names.</i>	<i>Addresses.</i>	<i>Subjects of Design.</i>
Oct. 8	2471	Miall, Marshall & Co.	Ingram-court, Fenchurch-street	Duplex flanged pipe joints.
"	2475	William Chapman	Johnson-street, Clonmel, Tippe- rary	Grain crusher, and regulating feed, for facilitating the grinding of meal and flour.
9	2476	William Lowe	Birmingham	Bolt.
10	2477	Louis Dutreilh	Wellington-street, Strand	Plantiform or instrument for mea- suring the feet of horses for fa- cilitating shoeing.
"	2478	Morris Gardiner	Ashill	Lever spring-drop.
11	2479	John Gray and Robert John Keen	Liverpool	Anti-vibration elastic compass disc.
12	2480	John Smith	Uxbridge	Revolving sifter.
14	2481	Thomas Smith Free- man	Fenchurch-street	Safety pocket for waistcoats.
15	2482	Charles Beinhauer	Hamburg	Economical registered stove.
"	2483	George Rolfe and Wil- liam Stacey	Bradford	Perforated ventilating valve cover.
16	2484	John Nurse	Crawford-street	The cabriolet or curricule Brough- am, with self-acting step-piece.
"	2485	John Raphael Isaac	Castle-street, Liverpool	Cork or stopper.
17	2486	Gustavus Ed. Beckers	The Railway Station, Paddington	Self-acting sliding stop.
18	2487	Cook and Williams	Prince's-street, Hanover-square	Respirator stock or tie.
18	2488	Cook and Williams	Prince's-street, Hanover-square	Face and chest protector.
18	2489	Susan Walker	Tyc Grove, Hersham, Surrey	A partinette.
21	2490	William Towns, B. A.	St. John's College, Cambridge	Spirit meter.
22	2491	John Scholl	Berwick-street, Oxford-street	Smoke consumer for gas-burners.
23	2492	George Mosley	John's-place, Grange-road	Safety pin.

London Mechanics' Magazine.

CORRESPONDENCE.

Correspondents will understand very readily the value to us of their names and addresses. If they desire their contributions to appear without their signatures, they have but to express it; but, as an earnest of their good faith, and that we may know to whom we are really indebted, we must request that their real signatures accompany their communications. And "Carick" is especially informed, that his contributions would not be the less valuable were his real name appended to them, precisely as many a bank-note is taken to be genuine from a knowledge of the handwriting of the cashier. He is also informed that his article on "Finance" was read with interest, but is considered as unsuited to the character of this publication. We hope to hear from him again, however.—"Sit lux" is advised that the subject is one in which we (both public and Editors) have too long groped in more than Egyptian darkness—if there be light in him, let it appear.—In answer to the query of "W. S." we would remark, that quite a sharp discussion has arisen out of this matter, and, as is usual under such circumstances, the true merits of the question have been lost sight of, in the personal feeling engendered by the controversy. Mr. Fairbairn has published two vols. Mr. Thomas Fairbairn has also published under the title of "Truth and Tubes," Edwin Clark has published two large volumes of the Conway and Britannia Bridges, by permission of Mr. Stephenson, with folio plates, and many others have written and published with a view to the settlement of this much disputed question. The articles on this subject, published in the later numbers of the *London Mechanics' Magazine*, are well worth reading; likewise an article in the October No. of the *North British Review*; and although *Punch* is not usually considered a standard in mechanical matters, we quote from a late number to the effect, that "Mr. Stephenson must henceforth be regarded as the greatest of engineers, as, whatever difficulties others may have had to encounter, no one ever passed over so Menai Straits."—"A. W. C." We do not hesitate to say that the admiral is no authority in this matter. Were the question a purely nautical one, or one approaching the science of hydraulics no nearer than

the determination of the value of *two-water grog*, we should say his opinions might be entitled to some weight, but in no other branch of hydraulics with which we are acquainted would it be safe to rely on his judgment. His friend, who aided in the capture of the 32-pounder, evinced full as much nautical skill as the admiral, and we should judge that if his opinion had been given on this matter, it would be entitled to consideration as coming from a man of evident *thought* as well as action. The discussion of the question, however, can scarcely be considered as coming within the scope of this Magazine.—"R. E. X." is referred to Appletons' Mechanical Dictionary for the process of manufacture. German gun-barrels are considered very inferior to English, and even to our own, and the opinion that a curved gun-barrel will shoot in a curve, is erroneous, a Major of engineers to the contrary notwithstanding.—The "Student in Architecture" asks why it is, that in most architectural compositions the elaborate ornament on the façade, if there be any, is confined usually to one story, and not carried throughout the front, and whether there exists any authority for the practice in the writings of the masters? We are not aware of any precise rules on this branch of the subject. A painter would say, there must be in all compositions a feature, to which all others under the same view are subordinate. But a good illustration of the value of this rule may be seen in a glaring violation of it now in process of construction at No. 57 Broadway, where five stories of carved columns, precisely alike, totally destroy the effect of the front as an architectural composition. And in general, it may be considered, that the repetition of any one feature in a horizontal line pleases, let the extent of front be what it may; but this same feature, repeated in vertical lines, is attended invariably with a loss of effect. We are not prepared to give the reason of this, but have noticed the fact repeatedly; and to such an extent is it carried, that sometimes a feature very common in itself, becomes, by the horizontal repetition merely, imposing, while, on the other hand, the effect of a beautiful ornament is destroyed by its repetition in vertical lines.

APPLETONS'

Mechanics' Magazine and Engineers' Journal.

VOL. I.]

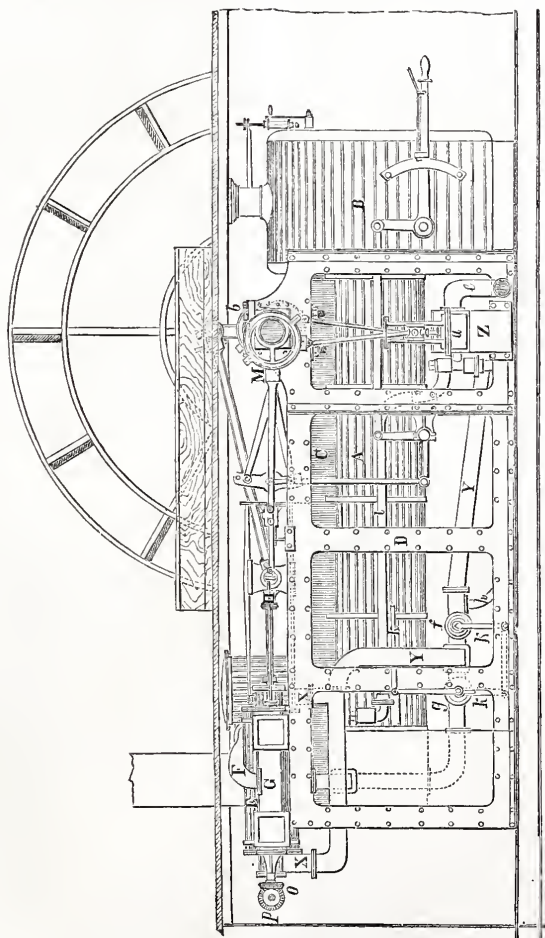
SATURDAY, FEBRUARY 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 2.]

MARINE ENGINES ON THE UPPER DANUBE.

Fig. 1.



Scale 4 feet to 1 inch.

MARINE ENGINES ON THE UPPER DANUBE.

From the Practical Mechanics' Journal.

THESE engines were designed by Mr. Joseph Hall, of Munich, and fitted in a boat on the Upper Danube.

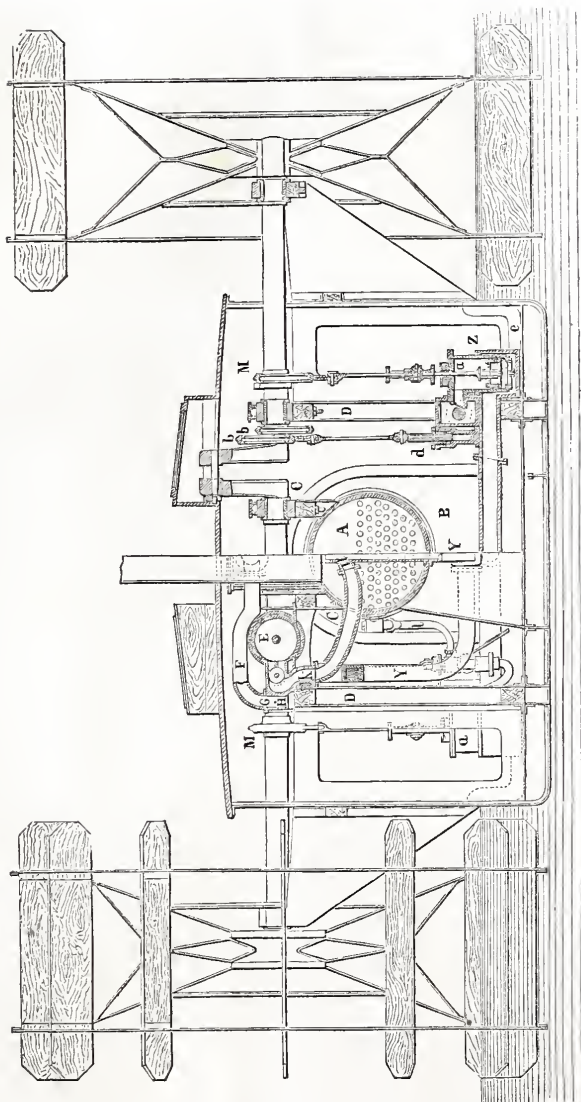
As the superintendent of M. Von Maffei's extensive engine works at Hirschau, near Munich, Mr. Hall has had several years' practice in building and fitting out steamers for the shallow and rapid Danube, and the present design will show what he has accomplished against the difficulties of lack of water and rapidity of current. In the hot season, the river has not above 18 inches of water in many places—so that, on the one hand, the draught of the boat is inordinately restricted, whilst it is absolutely necessary to use very powerful engines to overcome the current in running up the stream. The engines must, therefore, be large in comparison with the size of the vessel, seeing that a rate of ten miles per hour is to be maintained in the up trip.

In 1848, when the Bavarian government ordered another steamer for this navigation, Mr. Hall, after some consideration of the contradictory exigencies of the case, conceived the idea of constructing a high-pressure engine, on the principle of the ordinary locomotive, so as to economize space, stowage, and weight, as much as possible. As this idea met with the approval of M. Exter, one of the superintending government engineers, the boat was fitted out according to the new plan towards the end of the season of 1848, and has since been in regular employment up to the present date. She runs between Regensburg, Ratisbon, and Linz, and has answered sufficiently well to induce the government to order three more boats of similar construction, but still smaller, to suit the shallower water between Regensburg and Ulm.

During the fitting-out of the new steamer, Mr. Hall, whilst partly regretting the superseding of the old condensing engine, began to consider the advantages likely to arise from the combination of the high-pressure and condensing systems in one. His first idea was to make use of the waste steam to cause a blast for a steam generator through the blast-pipe; and, second, to condense the waste steam which the atmosphere prevented

from escaping. The original design was made in June, 1848, and was carried out in M. Maffei's establishment, under the auspices of M. Exter, and with the able professional assistance of Mr. Ashton, the English engineer of the works. The arrangement is very fully detailed in our three plates. Figure 1 is a side elevation of one of the engines, with boiler and paddle-wheel, as fitted in the vessel. Figure 2 is a corresponding transverse section through the vessel, showing both engines, with various parts in section. The view on the left of the centre line represents sections through the paddle-box, air-pump, feed-pump, crank shaft journals, condenser passage, and the barrel of the boiler—the cylinders not being shown. On the right, the air-pump and paddle-wheel are in elevation, the cylinder being in section through its exhaust passage, as in connection with the blast-pipe. Figure 3 is a plan of the combined engines, one being in horizontal section. The boiler and the fire-box, A B, are constructed just as in a locomotive. At C C, are two parallel frames of double-boiler plate, filled in with timber, running along the boiler, and riveted fast to it. D D, are two similar frames, standing up from the bottom of the boat; and these four lines of framing carry, at one end, the four inner journals of the paddle-shaft, and, at the other, the pair of steam cylinders, E E. The steam is admitted in the usual way by a regulator in the dome through the pipe, F, to the steam-chest, G. The slide-valves are made on the ingenious principle introduced several years ago by Mr. Bodner of Manchester. The expansion-valve spindle, H, has a right and left hand screw at I I, each screw having a plain cut-off slide, commanding the steam ports, J, leading into the second steam-chest, K, and fitted with piston-valves worked by the spindle, L. The cut-off spindle, H, is worked by the outside eccentric, M, the rod of which is linked to it direct. The variation in the expansion is effected by the light shaft, N, passing alongside the engines to the engineer's hand, and having a bevel pinion, O, gearing with a similar pinion, P, on the transverse shaft, Q, passing across between

Fig. 2.

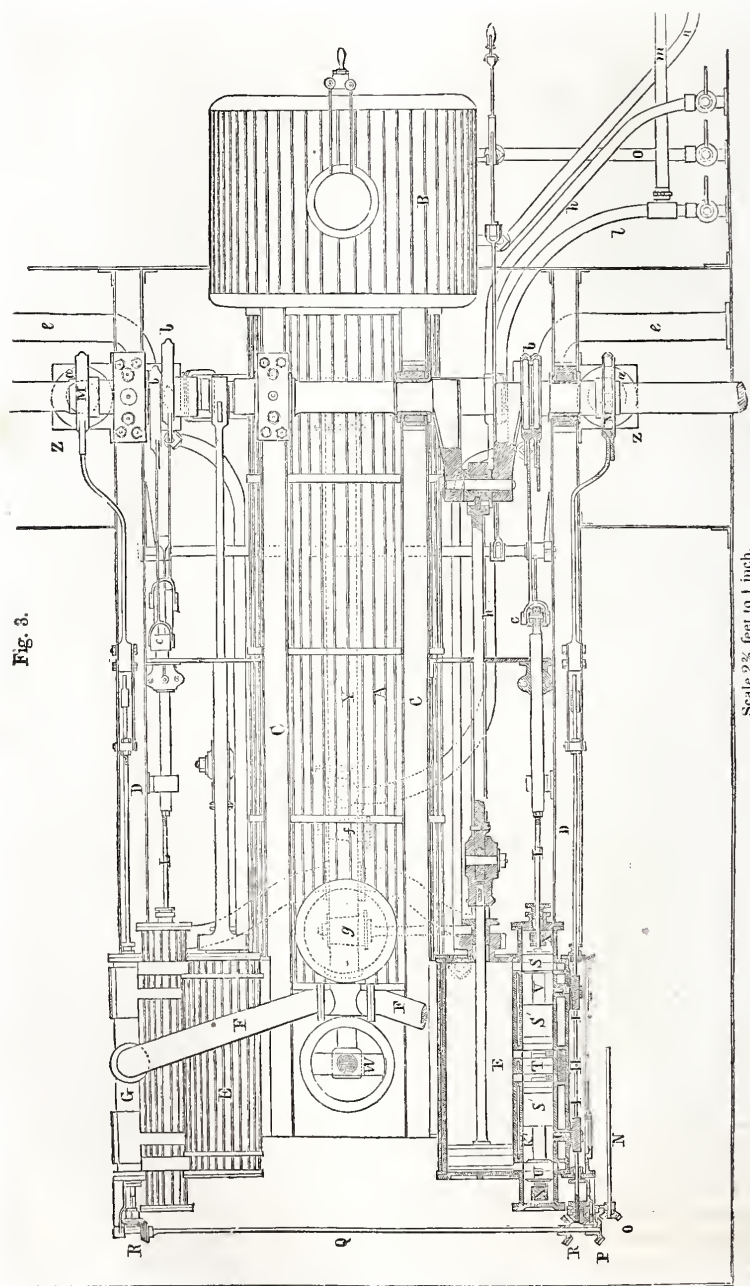


Scale 4 feet to 1 inch.

both engines. In this way the shaft, *n*, commands the valves of both engines through the two pairs of bevel pinions, *r r*—the result of turning the shaft, *n*, to the right or left being to expand or approximate the two cut-off slides by the right and left screws, and thus increase or diminish the degree of expansion with-

out affecting the lead. The cylindrical, or piston-valve chest, has three valves, *s t* and *u*, on the same rod, *v*; and, as represented in the horizontal section, plate 61, the engine is upon its bottom centre, and steam is entering between the valves, *v* and *t*; the valve, *v*, being on the point of opening to admit steam

Fig. 3.



Scale 2 3/4 feet to 1 inch.

to the cylinder—the waste steam of the previous stroke having escaped by the opening east in the middle of the cylinder, and through similar recesses formed in the valve, *t*, into the blast-pipe, *w*. Now it is to be remembered that the valve, *v*, must travel downwards until its port leading into the cylinder is full open; and, as the whole three valves are on one rod, as *v* is opening to admit steam to the cylinder, *t* is closing the communication between the cylinder and the blast-pipe. So soon as the ports to the blast-pipe—which are only half the width of the valve—are closed, the other valve, *s*, opens, and the remaining vapor escapes through the pipes, *x*, east on the steam-chest, to the pipe, *y*, leading to the condenser, *z*. As the expansion at each stroke commences at the face of the cut-off slides, whatever amount of steam may be in the piston-valve chest at the time is also expanded; therefore, to diminish this amount as much as possible, two additional pistons, *s' s'*, are fitted upon the valve-rod, for the purpose of displacing the steam which would otherwise collect at each stroke in the valve-chest. The air-pump, *a*, is of the ordinary construction: it is bolted on to the condenser, and is worked by the same eccentric which works the expansion valves. The piston steam-slides, *s* *t* and *v*, are worked by the back and forward eccentrics, *b*, *b*, through the reversing link, *c*. The backward eccentric also works the feed-pump, *d*—the feed being taken from the hot well, whilst the remainder runs to waste by the pipe, *e*.

The steam is admitted to the cylinder when the piston is on the centre, and is allowed to escape to the eduction-port or blast-pipe when the piston is $\frac{1}{4}$ th inch from the end of its stroke. The valve, *s*, opens to the condenser when the piston has travelled $\frac{1}{4}$ th inch from the commencement of its stroke—the full length of stroke being 30 inches—so that the cylinder is open to the condenser when the piston has travelled $\frac{1}{4}$ th of its stroke.

At *f* and *g*, two cocks are placed upon the pipe, *y*, leading to the condenser, and these cocks are so arranged that when one is open, the other is shut. The injection-pipe, *h*, is placed between the air-pump and the cocks, *f* and *g*, so that by reversing the latter by means of the rods and levers, *k*, *k*, the engine will work with the condenser or without it. When

working without the condenser, the cylinder is open to the atmosphere throughout the entire stroke, as in the common high-pressure engine. and under such circumstances the pipe, *l*, is open to the feed-pump for the boiler supply. The pipe, *m*, leads to a small steam pump not seen in the drawing, and the pipe, *n*, conveys the water from the steam pump to the boiler. The pipe, *o*, is the blow-off pipe.

As this plan presents many novelties, it was Mr. Hall's intention to have delayed making it known until further experience with it had shown how far it might be improved upon, but the appearance of Mr. Siemen's paper in connection with a scheme of a similar nature, has induced him to submit it to us at once. That the two inventions were entirely distinct, scarcely admits of doubt; but the fact of a steamer on Mr. Hall's plan being at work at the early date we have mentioned, sets at rest the question of priority.

The more extended adoption of the new arrangement by the Bavarian government will afford good opportunities for testing different modifications of the system, and we may probably, hereafter, be in a position to state the behavior of the three new vessels now being fitted out.

ON ANHYDROUS STEAM, AND THE PREVENTION OF BOILER EXPLOSIONS. BY DR. HAYCRAFT, GREENWICH.

From the London Mechanics' Magazine.

In the London Mechanics' Magazine, Mr. Frost, of New-York, has with much talent developed his views on dry or anhydrous steam, which, on the supposition of its having its own atomic constitution, he denominates *stame*. He has given experiments which open a vast field for improvement, and his conclusions lead us to believe that the power of the steam engine may be prodigiously increased. Having, about twenty years since, entertained nearly the same views as Mr. Frost, and having abundant reason to modify them, it may not be amiss to give an historical detail of the principal facts on which those opinions were founded. It will be at least advantageous to the reader, by warning him of those errors by which I have been misled, and will at the same time open to him the right path to improvement.

Being induced by the experiments of Broughton, who supposed that steam was 10,000 times rarer than water, and also by those of Desagulier, who put it down at 14,000, I experimented by weighing steam in a copper ball, and afterwards weighing the same after having immersed it in boiling oil for some time, for the purpose of superheating and rarefying the steam. The particulars of this experiment I need not detail, as it is, I now perceive, liable to the same objections as Mr. Frost's, which I will afterwards explain. The result was, that by exposing steam to the temperature of boiling oil, its specific gravity appeared to be lessened to about one-tenth; that is, it expanded to about ten times its former bulk.

Encouraged by this apparently satisfactory experiment, I had a small steam engine constructed, with a cylinder of 4 inches, and furnished with a tubular condenser, by which I could measure exactly the quantity of steam consumed. The cylinder was furnished with a jacket, which was supplied by a small high-pressure boiler.

On working the engine with ordinary steam, it required 85 revolutions to fill a given measure with the condensed steam; but on applying steam to the jacket of about 500 lbs. pressure, it required 920 revolutions to fill the same measure—the engine in both instances carrying the same weight on the paul. In this experiment, which was often repeated, it appeared that dry steam, or Mr. Frost's *stame*, is ten times more economical than ordinary, or hydrated steam.

Having succeeded thus far, a high-pressure engine was erected, with a 9-inch cylinder and 3 feet stroke: the cylinder was so constructed that a fire could be made round it, and at the same time the supply steam passed through tubes exposed to the heat of the furnace flues. The engine worked very well for some time, and with surprising economy of fuel; but, as might be expected, the parts exposed to high temperature gave way, and the engine became useless.

Afterwards I had a small engine, with the cylinder immersed in a mercury bath, with a metallic piston; this engine also gave great satisfaction for a time. It however occurred to me one day to make a calculation of the actual working of

these engines; and I found, to my astonishment, that, although my rarefied steam or "*stame*" had, as I believed, ten times the rarity of ordinary steam, yet its performance was in all these cases about equal to what it should be, supposing it to have the rarity ascribed to it by Watt—namely, 1728 times greater than that of water. On examining this subject carefully, I fortunately recollected the remarkable admission of Watt, that in his best engines there was a consumption of steam double of what was required by calculation. We have here two remarkable facts: one is, that a large engine, of Watt's best construction, consumes twice as much steam as it should by calculation; and the second is, that a small engine, carefully made, requires ten times as much as is sufficient under a different management.

This must be explained either by supposing there is some waste in the usual mode of operating with steam, or that, by superheating it, there is an absolute expansion of its volume.

To settle this latter point, the following experiment was made, which, though performed many years since, has never been published. The experiment was designed to ascertain the density of steam, but chiefly to determine what effect a superheating of it would produce.

A graduated tube was filled with mercury, the upper end being closed, and the lower immersed in a basin of mercury. Oxygen and hydrogen were introduced in the proportions which constitute water, to a certain mark which was noted. Two coated wires being introduced at the lower end, the gases were detonated, and, of course, reduced to water. The whole was placed in an oil bath, gradually heated to 210° , when steam was formed filling the tube to a point marked. On this, a calculation was made which came so near 1728, the expansion assigned by Watt, that I was satisfied of its general correctness. Having ascertained this point, I proceeded to determine the other, which to me was of the greatest importance, namely, how far an additional temperature would expand the steam, expecting that, at all events, it would have as much effect as is ascribed to it by Gay Lussac and Dalton, namely, as doubling the volume for every 480° . My surprise was indeed great, when I

found that an increase of 10° made no perceptible difference in the volume of the steam. I then gradually raised the temperature of the oil bath to 285° without perceiving the least expansion; indeed, it appeared very slightly to have contracted its bulk—arising, I suppose, from the expansion of the glass tube. I did not raise the temperature higher—my apparatus, unfortunately, not admitting of it—and I was completely satisfied that an additional temperature of 75° did not expand the steam. The experiment was several times repeated with the same result.

How can this experiment be reconciled with those of Mr. Frost, who finds that an addition of 4° doubles the volume of the steam? There is such an air of candor about Mr. Frost's communications, that I am disposed to give full credit to the facts which he details; and the only way I can think of to reconcile the discrepancy, is to suppose that some mismanagement has taken place either in his experiments or mine. On examining his apparatus, as represented in figs. 4 and 5, page 252, No. 1390, and his mode of using it, I find that the whole syphon is filled with water, which, being converted into steam at a high temperature, the superabundant water escaping, is thereby filled with *stame*. The syphon being then hermetically sealed up, was suffered to cool;—an engineer's vacuum, as he aptly terms it, is formed. Now, in this process it must be observed, that the whole interior of the syphon must be covered by very minute globules of water. The mercury is then introduced, which would fill the syphon with the exception of these minute globules, which would be everywhere interposed between the quicksilver and the inner surface of the tube. Then, on applying heat at the boiling point, the globules of water at the upper part of the syphon only are converted into steam; the remainder is kept in the aqueous form by the weight of the column of mercury incumbent upon it, so that it is no wonder that an addition of 4° temperature would convert some of the globules of water into steam of double the whole column. The other instruments used by Mr. Frost are still more complicated, and I fear in their use would give rise to the same errors; and, as all the experiments

were conducted in nearly the same manner, the results would be similar in them all. In such experiments the utmost care should be taken to operate in perfectly dry tubes.

Having said thus much in reprehension of the mode in which Mr. Frost's experiments were conducted, I will gladly take this opportunity of acknowledging the great importance of the experiments themselves, and of the relation of oil of turpentine and the fixed oils to minute globules of water exposed to high temperatures. His papers deserve a most attentive perusal, especially his remarks on boiler explosions, to which we shall refer.

We shall now be able to return with advantage to the fact, that in the small engine spoken of, as an additional temperature does not expand the steam, and as when the steam was superheated the engine consumed only the quantity that it should have done by measurement, it will follow that the same engine, when it was worked with ordinary steam, and consumed ten times as much as in the former case, must have consumed ten times as much as it ought to have done by measurement. Then comes the question, What occasions the loss? The same question applies to the other case, namely, What occasions the loss of one-half of the steam, which, we have seen, was the opinion of Mr. Watt himself, in his best engines? It has been stated that Watt ascribed this loss to unavoidable leakage by the piston, &c.; but on consulting several engineers on the subject, it appears that no very considerable loss could happen from this cause, as he took great pains in the finishing of his cylinders and pistons. It also appears that he had at least a suspicion of the true cause, which will be hereafter explained; namely, a cooling which takes place within the cylinder. The evidence of this is, that he took great pains to prevent it by clothing the working cylinder with non-conducting substances, and even by surrounding it with steam in a jacket.

While conversing with my brother on this subject, he remarked that he thought the cylinder was cooled by the evaporation which took place within it during the time of the vacuum, as the interior surface must be covered with a film of

water every time the steam is admitted. The cause of the evil now appeared quite clear. The engine at first starting is, of course, colder than the steam; it therefore becomes loaded with the water; a vacuum is made in the cylinder; the water within is rapidly converted into steam; it derives its combined caloric (1000°) from the metal of the cylinder and piston; these are cooled down by the abstraction of as much caloric as entered into the composition of the steam thus evaporated. Again; the supply steam is admitted into the cooled cylinder, and is condensed until the apparatus is raised to its own temperature; and not till then does it begin to act. Hence arises a fresh deposit of water, which is again evaporated with a production of cold; and thus the process continues as long as the machine acts. And here it may be noted, that this process constantly takes place in double-acting engines, for the vacuum process is constantly occurring either above or below the piston. On the other hand, in the bastard or Cornish engine, the vacuum takes place alternately, and only during one-half of the time the machine is in action. This may well account for the general economy of this machine. In addition to which, the adaptation of the steam-jacket—a fact now ascertained—will, as Mr. Frost observes, explain in part their vast superiority. The clothing of the boilers and steam pipes, and of the cylinder, together with the management of the furnaces, may also be considered subsidiary to their effect. Having thus ascertained the cause of the great waste of steam, it now became the question, How was it to be remedied? It was evident the plans hitherto pursued would not be practicable. It would be impossible to surround the cylinder with steam of the pressure of 500 lbs.; and I had ascertained that less would not effect the object even on so small a scale. Also, I had found that passing steam through metal pipes, exposed to the action of the fire, or of heated flues, was attended with practical difficulties which were insurmountable. It then occurred to me that, as it was only required to raise the temperature of the cylinder a trifle above the condensing point, this might be effected, provided the whole of the supply steam were raised to an equal temperature, and that all un-

combined water were prevented entering with it. In order to effect this, it was necessary to have a very extended surface applied to the heating steam. I found afterwards that a fagot of tubes, being surrounded by the same steam that heated the jacket, answered the purpose. This fagot, being inclosed in a portion of the steam pipe, or in the heating boiler, I called a steamer.

The apparatus was applied to an engine belonging to Mr. John Penn. This engine was employed in turning one pair of millstones, and it was ascertained, by measuring the coals and wheat, that the consumption was 3.6 lbs. coals for each bushel of wheat ground.

This, considering the smallness of the engine, and its being of low pressure, is less than in any engine yet known; for even Wolf's engines on a large scale, with high-pressure and expansion cylinders, consume from 3 lbs. to 6 lbs. for each bushel. I have since ascertained by calculation that this engine expended little above 8 per cent. more than it should by measurement, while even the Cornish engine expends 33 per cent. more than the proper quantity.

On experimenting, however, with this engine, I found I had not produced the maximum effect. In order to explain this clearly, I will state the mode by which this was ascertained. The index of the injection valve was set to a given point; the temperature of the injection water was ascertained, also that of the hot-well; the difference of these in any one experiment compared with the difference between them in another, the quantity of the injection being constant, will give exactly the comparative quantities consumed in each case. By experimenting in this way, I found that on raising the pressure of the heating boiler from 30 lbs. to 60 lbs., and even to 120 lbs. on the square inch, the temperature of the hot-well still diminished. This put me to contrive again; for it was evident that such high pressures were inadmissible, and yet I was desirous of producing, if possible, the maximum effect. A plan then occurred of a priming or separating-box of a very simple construction, which, by giving a circular motion to the supply of steam before entering the siccator, would, by the centrifugal force acquired by the free water

which always rises from the boiler, be separated and fall to the bottom of the apparatus. This priming-box was consequently applied, when I was gratified by observing its effect; for on raising the temperature of the heating boiler from 29 lbs. to 90 lbs., no diminution of temperature took place in the hot-well. This was a full proof that the maximum power of the steam was produced. The pressure of the heating steam was afterwards diminished to 15 lbs. on the square inch, on which an increase of temperature took place in the hot-well of 5 per cent. The pressure in the supply boiler was 6 lbs., so that a difference of about 9 lbs., or about 18° , is sufficient to enable steam to produce nearly its full dynamic effect. This difference would suffice, but, by increasing the surface of the tubes in the siccator, the maximum effect may be easily produced at a less temperature.

About this time the matter came under the notice of the Admiralty, and the Lords were pleased to grant a sum for experimenting on this engine. The experiments were conducted on the same plan as before, except that a dynamometer was applied, which was loaded to indicate about 18 horses power; which same power was also shown by the indicator. The experiments were under the inspection of the Comptroller and Inspector of Steam Machinery, and performed by Mr. Wright, one of the engineers of the Admiralty. The experiments were comparative, and showed the expenditure of steam under equal loads; first of the engine without steam in the jacket, then with ordinary steam in the jacket, and lastly, with the siccator, &c., as above described, added to the engine. The temperatures given to the injection water being ascertained, and the power being inversely as these quantities, it appears that the apparatus produces a saving of 25 per cent. compared with the engine with ordinary steam in the jacket, and of 46 per cent. compared with the engine without steam in the jacket.

These quantities, however, must not be considered as indicating the whole of the saving which would be produced by the application of anhydrous steam to engines in general; for this reason, that the engine on which the experiments were performed was so arranged as to produce the

best possible effect without its use; for in addition to the engine being made by a first-rate engineer, there was abundant steam room in the boiler, the steam pipe was large and inclined downwards to the boiler, besides which the steam was applied to the jacket, not as is usually done, but in the same way as in the Cornish engines, or rather in a somewhat superior manner, as the cylinder cover was covered with steam, and every pains taken to insure the perfect action of the old method. On the other hand, in locomotive, or even in marine engines, where there is a confined steam space,—and especially in locomotives, in which an enormous power is forced from small boilers,—there must be a very serious loss by the use of steam hydrated in a very high degree. The value of anhydrous steam in these cases can hardly be sufficiently appreciated.

The makers of locomotives appear to be aware of this in some degree, as in the newest engines the steam room is increased by means of large steam chests, &c., as much as the confined space will admit: but after all is done, the almost ruinous expense of repairing these machines, attests the evil effects arising from the present system. Capital would be well engaged in carrying out this plan with respect to locomotives and marine engines.

In consequence of these experiments, which were repeated in a variety of ways, a recommendation was made to apply the apparatus at the Government expense. This was about being done when its progress was arrested, in consequence of new regulations respecting experimental matters.

Another remarkable fact was observed in these experiments; namely, that with the apparatus, that is, with the use of anhydrous steam, the engine would carry above one-fourth more load, or, in carrying the same load, an expansion being put into action, there appeared a saving of 59 per cent. compared with the engine working in the ordinary way.

That steam should undergo no expansion by an increase of its temperature appears somewhat anomalous; yet this may be considered as one of the interposed laws of nature, somewhat analogous to the increase of volume in water by the abstraction of caloric between the

temperature of 40° and 32° . If it were not for this law, lakes and rivers would be frozen from the bottom, and a constant winter would reign even in the temperate regions: an equally good reason, or final cause, may be given why the vapor of water should not expand by an increase of temperature; namely, that earthquakes and other convulsions of nature, being probably caused by sudden evolutions of aqueous vapor occasioned by subterraneous fires; had the usual law of expansion by heat held place, and, much more, had the aqueous vapor been converted into "stame," the very earth would be shattered to pieces, no rocks nor hills could withstand its force, and the world would become one mighty ruin.

There is one more interposed law of nature, which is, perhaps, as important as the two I have mentioned. In some experiments which the Royal Society of Edinburgh did me the honor of publishing, it has been shown that the air of expiration in animals contains very much less combined caloric than the air of inspiration, chiefly in consequence of the vapor of water combined with it. From this it appears that the process of evaporation which continually takes place in the lungs, instead of having a cooling effect, as in every other case, becomes actually a heating process. It appears, therefore, that had this interposed law not had existence, animal heat could not be sustained; and should this law be suspended for one hour, the consumption of carbon in the system being insufficient to maintain the animal heat, the whole animal race would sink into torpidity and death. That evaporation of water should, under any circumstances, occasion an evolution of caloric, is almost incredible, but not more so than the two interposed laws I have just mentioned.

Mr. Frost and myself, though we vary somewhat, agree in the more essential points. There is even a striking accordance between us. He finds by experiment that an addition of 4° doubles the volume, and I have shown that in an 18-horses power engine, the power is nearly doubled,—that is, 46 per cent. is added by a temperature which certainly did not exceed 4° in the cylinder. He also states, that by an addition of 440 lbs. the volume of steam heated out of contact with water is increased nearly tenfold;

and I have shown that in a small engine, by the application of steam of 500 lbs., the effect of the steam was increased more than tenfold. The advantage of heating the steam is nearly the same on both hypotheses. We differ chiefly in theory. Mr. Frost supposes that steam being subjected to a higher temperature, is converted into "stame," while I believe that "stame" is nothing else but pure anhydrous steam. In practice we also agree, excepting that he proposes the very means which I used many years ago, and which were abandoned, not because they were inefficient, but because they have been superseded by more useful and practical methods.

As to the amount of advantage to be derived from the use of anhydrous steam, it will vary in each case. It would be imprudent to expect too great things, but I have shown that in a very small engine the saving was 90 per cent.; and that in an 18-horses power with abundant steam room, it would amount to 46 per cent. It is also probable that in the same kind of engine the saving will be inversely the size of the engine, in some proportions or other. Thus the diameter of the small engine compared with the other was 1 : 6, and the saving was 90 : 46—then if we suppose a 12-feet cylinder which would be six times the diameter of the 18-horses power, the saving might be lessened in the same proportion, the 90 : 46 :: 46 : 23 $\frac{1}{2}$ per cent. In actual practice the saving will be very much greater, for the reasons I have before stated. I have shown in the Appendix that the proper quantity of good coal for condensing low-pressure engines is 3.29 lbs., per horses power per hour, while in practice the consumption is not less than 6 lbs. and up to 18 lbs. I have shown also that the Cornish engine, with all its vaunted powers, instead of consuming 1.47 lbs., per horses power, consumes 2.21 lbs.,—being a loss of 33 per cent.; while, on the other hand, I have shown that a low-pressure engine, driving only one pair of millstones, and with the siccator, &c., consumes 3.6 lbs., while by measurement it should consume 3.29 lbs.,—being a loss of 8.7 per cent. only. Compare this with other engines of this class, which consume from 46 to 80 per cent. more than the proper quantity.

An anhydrous cylinder is also especial-

ly favorable for working the steam expansively. The cylinder when sustained above the condensing point allows of the full effect of the expansion according to the theory of the hyperbolic curve.

I will make a few remarks on the use of the priming-box, which so materially assists in drying the steam. I have even found it very useful when used by itself. It is applied to one of the river steamers, and by repeated experiments I have found that it effected a saving of 7 per cent. The engineer told me that with this apparatus he could drive the engines for a whole week, without blowing out the boiler, and without priming the engine, while without it it was necessary to blow out twice or three weekly. This little apparatus, which can be applied to any engine at a small expense, deserves the especial notice of engineers. It would soon save itself by the protection it would give the cylinder, piston, and slides from dirt and scales from the boiler.

Prevention of Boiler Explosions.

We now come to the very important subject of boiler explosions. Mr. Frost has so ably explained the most frequent causes of them, that little more need be said on the subject. The fact is, that they take place not when the steam is at its full tension, as when, for example, the engine stops for a time; but after the engines have started again, and made some revolutions, and the tension of the steam is suddenly reduced. The cases of explosion usually happen when the water supply has been neglected, and a portion of the boiler not covered by the water becomes red-hot. The explanation may be as follows: The engine having stopped some time, has become cold, then, agreeable to the principles above stated, the steam on entering the cold cylinder is rapidly condensed during the several revolutions; a large quantity of steam is rapidly drawn from the boiler, the water therein being of a high temperature, and being also suddenly relieved from a considerable portion of the steam pressure, boils rapidly, throwing up priming water, which coming into contact with the red-hot plates of the boiler, a sudden evolution of steam takes place, in such quantity as to act like detonated gunpowder; so that no boiler, however strong, can resist its violence. Those who are conversant with the river steamers will have

observed that, after each stopping, the engines, especially if the boilers are very foul, prime very much; that is, the noise of the ebullition water rushing into the cylinders can be distinctly heard. Now, in such a case, if the water in the boiler happen to be extremely low, there would be the utmost danger of an explosion.

Besides the obvious propriety of keeping the boilers clean and well supplied with water, it will appear quite clear that even should these precautions be omitted from carelessness, the use of anhydrous steam would inevitably secure us from such disasters, for the following reasons; and it is a fortunate circumstance that what was designed merely to save expense should also be the most efficient means of securing our safety.

Should the engines stop for any time, the cylinders being constantly maintained above the condensing point of the steam, the engine on starting would require no more steam than usual; there could be no sudden abstraction of steam from the boiler, and, in short, the whole train of causation, before described, being prevented, no explosion could ever occur. Even a common steam jacket would in some measure diminish the danger. I have never myself heard of any boiler of a steam engine having a jacket, exploding from this cause. This subject really deserves the attention of engineers, as we have it in our power to prevent the greater number by far of these serious accidents.

Jackets have been discarded from most engines, because they have been found to produce but little saving of steam in those engines in which there is but little steam space; so that with the exception of the Cornish engine, steam engines have retrograded, as Mr. Frost says, since the time of Watt.

As a measure of safety in boilers, the use of the priming-box promises great security, because most explosions arise from priming. All boiler explosions, in fact, arising from priming, excepting those few which are occasioned by an undue proportion between the tension of the steam and the strength of the boiler, that is, by the boiler being worn out by too long use or from improper construction. This cannot happen but from the most culpable negligence. I have shown above, that by this means, a river steamer could

be worked seven days instead of two, without blowing the boiler. The cause of this is, that the apparatus receives the priming on starting the engine after stopping, thus preventing it from entering into the engines. This prevents in a great degree the cooling down of the cylinders, and the consequent great demand for steam, by which the boiler being partly exhausted, the priming rises in great quantities and produces the effects that have been described. This simple apparatus may be applied at a small cost to any steam engine; it occupies a small space, and has, besides the security it affords, the advantage of saving from 7 to 10 per cent. in the fuel. This subject deserves investigation, and should these premises be correct, no engine, and especially no river steamer, where the water is constantly foul, should be unprovided with this apparatus.

The burning of locomotives, which so frequently happens, and which is attended with such enormous expense and inconvenience, arises also from priming. It is reported in the *Observer*, that six engines belonging to the Eastern Counties Railway were burnt between the 18th and the 21st of August last. The immediate cause of this mischief is a deficiency of water. But this deficiency of water is occasioned by the great quantity of priming which takes place in the engines whenever the boilers become foul. This is far more probable than that the engine-drivers neglected to provide the usual quantity of water; and it is highly probable that in these cases the boilers had been tampered with. An efficient priming-box would have prevented these accidents.

It would certainly be desirable to construct steam engines in such a way that safety depends as little as possible on the carefulness or negligence of engine drivers and firemen. This security, I believe, is effected by the anhydrous system.

As a summary of what I have stated, it has been shown that "stame" is nothing else than pure or anhydrous steam; that steam engines consume by measurement from one third too much, as in the case of Cornish engines, to near six times the proper quantity of coals; that this loss is occasioned by the use of hydrated steam, and by the coldness which it occa-

sions in the cylinder; that this coldness is caused by a constant evaporation which takes place within; and also that this evaporation is prevented by a steam jacket containing steam, which shall sustain the temperature of the cylinder slightly above the condensing point, together with the use of anhydrous steam, and this may be accomplished with a great saving of fuel.

That boiler explosions arise chiefly from priming, which takes place in consequence of the cylinder becoming cold after stopping—together with a deficiency of water in the boiler, which thereby becomes red-hot; that this priming still farther cools down the cylinder, causing a still greater exhaustion of steam, and consequently a more violent ebullition, which, acting on the red-hot boiler plates, causes such a sudden and copious production of steam, that the explosion takes place; that a heated cylinder, together with a priming-box, &c., would afford perfect security against these accidents, even should the boiler become foul or deficient in water. That an efficient priming-box alone would offer a good security against boiler explosions; and, lastly, that the burning of locomotive engines arises from the same cause, and would be prevented by the same means.

There are many points concerning priming, which had I space might be pointed out; such as the priming of sea-going steamers on entering fresh water, which arises from the high temperature the water acquires in consequence of its impregnation with salt. This high temperature converts the fresh water supplied into the boiler into steam too suddenly, which is also not unattended with danger.

I will just mention one fact which, although apparently insignificant, shows in a striking manner the effect that an admission of a very small quantity of water has in cooling down the cylinder. While experimenting on the engine referred to, I blew the slide case, and then remarked the effect produced on the hot-well. The difference of temperature previously was 20° , but after blowing the slide case the temperature fell 3° , showing a saving of 15 per cent. It was, to be sure, a long T slide, which would increase the quantity of the water of condensation. This shows that apparently trivial circumstances deserve attention. I am aware of the

Fig. 1.

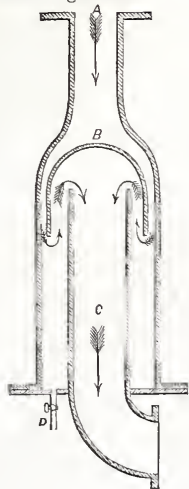


Fig. 2.

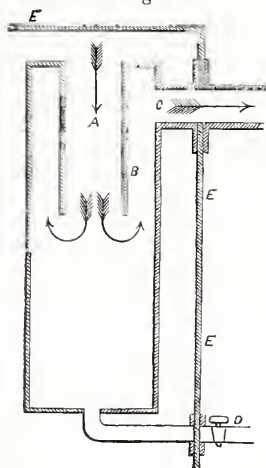


Fig. 3.

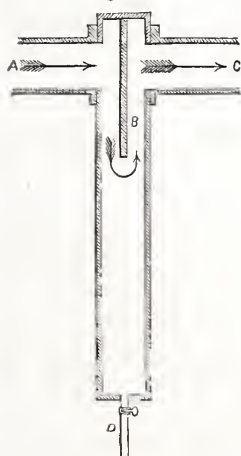
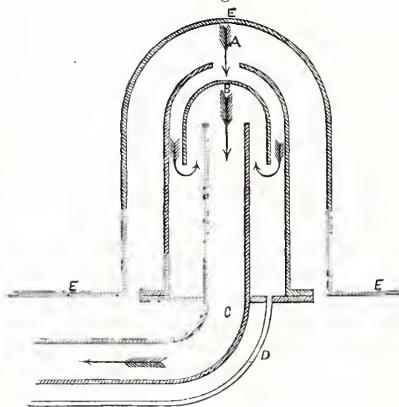


Fig. 4.



natural aversion which engineers have, in common with others, to new plans designed for the improvement of their own art; yet I trust some will be found who will investigate these matters, and regard their noble profession not so exclusively as men of business as to prevent them from promoting whatever may contribute to the purposes of general utility.

Fig. 1 is a priming tube or separator: it forms a part of the steam pipe, and is placed close to the engine, or else receives the steam before it enters the sic-

cator. The steam enters at A, follows the direction of the arrows on the outside of B, which is an inverted cup-shaped cylinder, suspended by strips to the external chamber. At the lower curved arrows, the water is separated and falls to the bottom; the steam then passes into the engine or siccator. D is a stop-cock to blow the apparatus.

Fig. 2. The same description and letters apply to fig. 2. This priming-box may be placed within the boiler, and is designed especially for river steamers, or

wherever the water is very foul. E, E, E, a portion of the boiler.

Fig. 3 is a cheaper form of the apparatus. It consists of a cast-iron box in the form of a parallelogram. The water is separated by passing under a diaphragm B, and makes its exit at C. D is the blow-cock. This form is useful where the steam pipe runs in a horizontal direction.

Fig 4 is a modification of fig. 1, and is suited for insertion in the dome of a locomotive: this and fig. 2 require the addition of fig. 1 or 3 to receive the condensation of the steam pipe. E, E, E, is the dome.

Appendix.

A list of different steam engines that have come under my observation, with the quantity of coals consumed per horse power per hour.

	lbs.
Cornish engine at Deptford, see below	2·21
Wolf's engines at Greenwich, ditto . .	3·
High and low pressure engines at Greenwich, 40-horses power . . .	6·
Average of five pair marine engines (Tredgold) nominal	10·3
Corn-mill at Deptford, 12-horses power, low pressure	14·0
Messrs. Johnson and Berry's engine at Birmingham, 8-horses power nominal	16·
Mr. Smith's engine, almost new, at Bermondsey, 5-horses power nominal	18·88

Calculation to show the quantity of Coals which should be consumed by Steam Engines per Horse Power per Hour:

Note.—The capacities of steam, of all densities, is supposed to be constant, that is, as the density. Also that a horse power is equal to 33,000 lbs. raised one foot in the minute.

One cubic inch of water = 1 cubic foot of steam (Watt), of the elasticity of 15 lbs. on the square inch = 144×15 lbs. = 2160 lbs., which would be lifted during its formation one foot high: and if this be done in one minute of time, $2160 : 33,000 :: 1 : 15 \cdot 27$ cubic inches of water required in one minute, or 916·2 cubic inches required in one hour = (1 cubic foot = 62·5 lbs.) 33 lbs., to which add one-fifth for friction and loss, or 6·6 lbs., total water 39·6 lbs.; and if we allow 1 lb. of coals to evaporate 8·4 water (Tredgold) the consumption of coals will be

$$\frac{39 \cdot 6}{8 \cdot 4}$$

or 4·71 lbs. per horse power per hour.

But if the steam work expansively, this quantity is divided by the number according to Watt's Table, which corresponds to the degree of expansion. Thus, in Cornish engines, the steam is stopped at one-eighth, and by the Table the performance is multiplied by 3·2; therefore the consumption of coals for these engines should be

$$\frac{4 \cdot 71}{3 \cdot 2} = 1 \cdot 47 \text{ lbs.}$$

per horse power per hour.

Again; in Wolf's engine, in which the expansion cylinder is four times the size of the other, and therefore, *pro tanto*, the steam is stopped at one-fifth. This, by the Table, multiplies the performance by 2·6; therefore, take the above constant quantity 4·71 as before, and

$$\frac{4 \cdot 71}{2 \cdot 6} = 1 \cdot 81 \text{ lbs.,}$$

the quantity which should be consumed by these engines; but they consume 3 lbs. per horse power per hour, and some of them twice as much.

Also in low-pressure engines, which use a slide valve. The slide stops the steam at two-thirds, which multiplies the performance by 1·43; then

$$\frac{4 \cdot 71}{1 \cdot 43} = 3 \cdot 29 \text{ lbs.,}$$

which is the proper consumption for these engines; but they actually consume from 6 lbs. to nearly 19 lbs.

Calculation to show the consumption of Coals in the Cornish Engine at Deptford, with the steam stopping at one-eighth, and using the best Coals.

Engine lifts 84,000,000 lbs. of water one foot high by the consumption of 94 lbs. of coals. If we suppose this to be done in one minute of time, the number of the horses power would be

$$\frac{84,000,000}{33,000} = 2545;$$

and if in one hour,

$$\frac{2545}{60} = 42 \cdot 45, \text{ and } \frac{94 \text{ lbs.}}{42 \cdot 45} = 2 \cdot 21 \text{ lbs.,}$$

or the consumption of coals per horse power per hour; but the proper quantity, as we have stated above, is 1·47 lbs.: being a loss of exactly one-third.

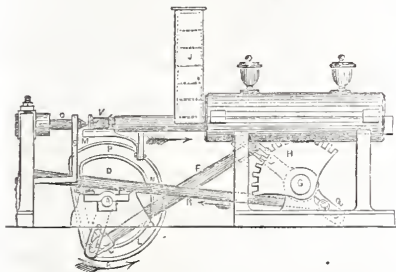
The only engine in which the siccator, &c., have been applied in an imperfect manner, and acting under disadvantageous circumstances, consumes 3·6 lbs., the proper quantity being, as above, 3·29 lbs., which is a loss of only 8·7 per cent. This is the near-

est approximation of any engine in existence to the true theory, and far surpassing the Cornish engines in effect, especially considering the vast difference in their size, pressure of steam, and the rate of expansion.

To exceed the theory seems not to be very probable, unless it should turn out—and the possibility of which I admit—that Mr. Frost's notions concerning the expansion of steam are correct. But without this, the room for improvement is very great, so much so that it may be considered that the steam engine is still in its infancy. It requires only the due application of capital to produce effects as yet unthought of.

W. T. HAYCRAFT, M. D., &c.

TURNING AND CUTTING WOOD.
From the Glasgow Practical Mechanic.



The "turning" machine or lathe of Mr. Findlay, recently patented in England, is intended principally for the manufacture of bobbins for winding thread, cotton, or other similar materials, but may be so modified as to be applicable to the production of button moulds and other articles where many of the same form are required.

As applicable to the former purpose, it is described as consisting of a bed or stand, on which are two standards or bearings to support mandrils, as in ordinary lathes:—one fixed, in which revolves a mandril terminating in a ribbed arbor or holder, and driven by a band and pulley:—the second movable, to suit the size of the article to be turned, and supporting a mandril or rod, sliding longitudinally, and connected to a lever whose fulcrum is on the side framing. The cutters are two in number; a plain or roughing tool, which consists of an ordinary chisel and two gouges, by the action of which the rough blank is reduced to a cylindrical form; and a compound finishing cutter, consisting of a

plain chisel, at each end of which is a chisel set at an angle to form the bevel of the ruff or collar of the bobbin or reel, and two other chisels which cut down the ends. These cutters have a traversing motion towards and from the material under operation, which is imparted to them by a crank lever, the end of which is attached to a driving shaft at the opposite extremity of the frame. This shaft also bears the stop or disengaging motion, consisting of a fixed clutch, into which a corresponding movable clutch takes, which is kept in contact by a helical spring attached to the side framing. The movable mandril or rod is produced and terminates in a slope, which rests on the boss of the second movable clutch piece, which is sloped, to allow thereof, to a corresponding angle. This rod also bears an angular bar, one end of which has an eye fitting over the first mandril between the standard and its arbor. When the lever is drawn back, the holder of the movable mandril is released from the bobbin, the sloped end of the rod bears against the boss of the movable clutch and detaches it, the angular bar slides forward by the same action, strikes the finished bobbin, and removes it from the arbor, and bears also against the cutters which are now at that part of their traverse furthest from the bobbin, detaining them whilst another blank, properly bored, is introduced between the mandrils. On bringing the lever forwards, the movable clutch is released, and, by the pressure of the spring, at once gears into its corresponding toothed piece, and the stop bar having been moved back by the advance of the lever, the cutters escape, and are allowed to complete their traverse towards the blank, which is held firmly between the mandrils, and which, when finished, can be removed by a repetition of the action above described.

The annexed engraving shows the mode in which these movements are made automatic, and for this purpose will be a sufficient illustration. This view is a front elevation of one of the headstocks, with the actuating mechanism for the whole of the movements. The headstocks stand as before, and the mandril carrying the bobbin blank is driven in the ordinary way by a strap, direct; but the rest of the movements are actuated by the trans-

verse shaft, A, which has upon it two scroll pulleys, or short cylinders, having endless differential spiral grooves cut on their peripheries, so as to produce a species of irregular right and left spiral in one continuous length. Each tool-holder has a pin projecting from its lower surface, down into the spiral grooves of its corresponding scroll pulley, so that the continuous revolutions of the shaft with its two pulleys, in one direction, traverses both holders back and forward to the extent of the run of the spirals. The action of these spirals is such as to give the tools a quick traverse when out of cut, and a slow one during the time they are actually forming the bobbin, the cutting action being at the termination of the stroke, just when the pins of the holders are passing the points where the right and left spirals join at their inner ends. The junction of the opposite ends of the spirals is effected by a straight portion, cut at right angles to the axis of the scroll pulley, and joining up to the spirals by quick curves; the object of this contrivance being to allow the tool-holders to come to a stop when drawn back for the adjustment of a fresh blank.

The main shaft, A, projects behind the two scroll pulleys, and carries upon its end a slotted crank lever, B, motion being given to the shaft by the belt-pulley, D. The pin, C, of the lever, passes transversely through the slot, projecting far enough on each side to enable its ends to enter the differential grooves, E, L, N, P, in the inner faces of two vertical disc plates, bolted down to fixed standards behind the headstocks. The pin, C, also passes through the eye of a connecting rod, F, the opposite eye of which is jointed to a pin adjustable in any fixed position in the slot of a crank-lever, keyed on a second horizontal shaft, G. This shaft has upon its front end a toothed segment, H, the teeth of which project through a slot in the lower side of the adjustable headstock, and gear with rack teeth formed on the lower side of the traversing bar, I.

The blanks for the bobbins are fed into the open top of the vertical supply channel, J, one above another, forming a column, as represented by the dotted lines. This channel, or case, if held in a fixed position, immediately over the

centre line of the traversing bar, I, by a bracket, and is open at both ends, the bottom one being grooved out to fit loosely over the bar which traverses beneath it.

In the engraving, the machine has just completed a thread bobbin, K, which is about to be removed from the mandril, in readiness for the supply to the latter of a fresh blank from the pile or column in the case, J. The pin, C, travelling in the direction of the arrow, is just about to enter the concentric portion, L, of the differential grooves, and this portion being curved to a radius equal to that of the crank, B, when the pin is at the extreme outer end of its slot, it follows that the crank communicates its full effect to the connecting-rod, F, at this point of its travel. In this way, the bar, I, is traversed outwards in the direction of the arrow, to release the finished bobbin, and take on a new blank.

A projecting bar is fastened to the lower side of the bar, I, to carry a small bracket or cup-rest, M. The bar is moved outwards until the cup comes beneath the case, J, when the lowest blank of the series drops off the top of the bar into the cup. To allow time for this movement, the grooves in the disc plates are formed as represented at the part N, being curved inwards toward the centre to a radius equal to the length of the connecting rod, F, so that when the pin, C, arrives at this point, it traverses through the curves without communicating any motion to the bar, I; the slot in the crank, B, allowing the pin to traverse inwards towards the centre of the shaft, to compensate for the variation in the differential curves. When the blank has been received into the cup, the bar, I, is traversed in the reverse direction, to carry the blank up to the arbor of the mandril, O, where it is turned as in the original arrangement. This opposite movement of the bar, I, is effected by the onward movement of the crank, B, the pin of which next enters the second concentric curves, P, corresponding to those marked L. To allow time for the cutting action, the differential grooves are formed with another distinct curve, as at E, diametrically opposite to those marked N, and are, like them, made of a radius equal to the length of the rod, F, so that when the pin arrives at this portion of its tra-

vel, it communicates no movement to the bar, *i*, until it re-enters the part *E*.

The self-acting motion for the removal of the bobbin now comes into action. This motion is effected by the crank, *q*, working the connecting rod, *r*, passing behind the headstocks to the back end of a double lever, the front end of which is jointed to a horizontal sliding bar, passed through the two standards of the fixed headstock as a guide, and bent up at a right angle, the end having an eye, *s*, fitting loosely to the mandril, immediately behind the bobbin. So soon as the bar, *i*, commences to travel outwards

for a fresh blank, the sliding eye, *s*, actuated as described, pushes off the bobbin.

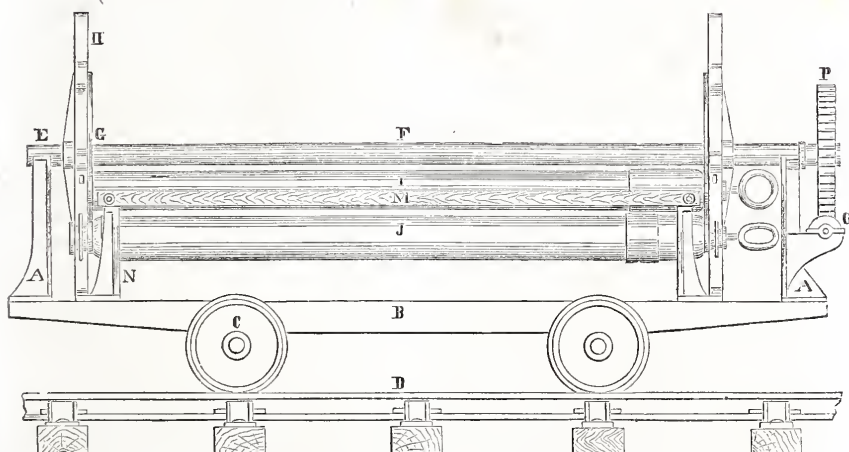
This machine is now working in Paisley, and effects a considerable saving beyond the best results of its predecessor. The "differential grooved disc and slotted crank movement" answers admirably for the compound uses to which it has been put, each of the movements being accurately timed for all the actions we have described. Its production is at the rate of thirty-four finished bobbins per minute, or about 140 gross per day of ten hours.

CORE CARRIAGE FOR MAKING AND DRYING CORES FOR METAL PIPES.

From the Practical Mechanics' Journal.

Registered for Messrs. D. Y. STEWART & Co., St. Rollox, Glasgow.

Fig. 1.

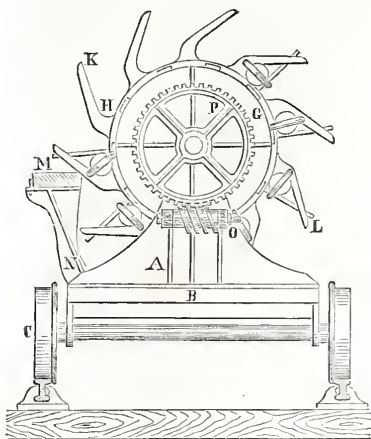


Our engravings represent two views of this "core carriage." Fig. 1 is a front elevation of it in a complete state; and fig. 2 is a corresponding end view. *A A*, are two end standards bolted down to the base-plate, *B*, which is carried upon the four wheels, *C*, fitted to run on the rails, *D*, for convenience of moving. These standards have bearings, *E*, on their upper ends, for carrying the horizontal shaft, *F*, which has upon it, near each end, a cast-iron disc, *G*. These two discs are set at such a distance asunder, as corresponds with the length of the cores intended to be made in the machine; and they are both fitted with a series of bearing

brackets, *H*, bolted or cast on to their peripheries at regular intervals, to carry the core bars, *I*. Each bearing bracket has an angular entrance-piece, *K*, for the convenience of placing the necks or ends of the core bars in the recesses of the bearings at *H*, the bars being retained in their places by keys, *L*, driven into suitable slots. The drawing exhibits the machine as provided with ten bearings, and in fig. 2, six cores are represented in their places; in fig. 1, one empty core bar, *i*, and one finished core, *j*, are shown.

The fixed loam-board, *M*, for shaping up the external figure of the core, is carried on a pair of brackets at *N*. Fig. 2,

Fig. 2.



exhibits a core bar as brought round opposite to the loam-board, in readiness for forming the core, which is made in the usual way, the bar being made to revolve in its bearings by a winch-handle. As each core is finished, the discs, *G*, are turned partially round by the worm, *o*, gearing with the worm-wheel, *P*, on the end of the shaft, *F*, so as to bring the succeeding core bar into the exact position necessary for the proper action of the loam-board. The effect of this arrangement is, that a number of core bars may be placed on the discs, and be coated as often as necessary, without being removed out of their bearings, by causing the discs to revolve on their bearings, *E*; and the carriage with the cores may then be at once run into the drying stove.

The apparatus is now in extensive use at Messrs. Stewart's works, effecting very great economy in core-making.

REMOND'S IMPROVEMENTS IN THE MANUFACTURE OF ENVELOPES. PATENT DATED APRIL 15TH, 1850. ENROLLED OCTOBER 15TH, 1850.

These improvements relate to the application of adhesive substances to the sealing flap of the envelope, and consist

First—in applying the adhesive or cementing material to the envelope papers in a dry, instead of wet or moistened state, as usually adopted.

Secondly—In removing the envelope papers from the machine or place where the operation of applying the adhesive material has been performed, by means of atmospheric pressure.

The machine for effecting these operations, is represented in the accompanying engravings, fig. 1 being a front, and fig. 2 a transverse elevation of the machine. Figs. 3 and 4 show a plan and section, upon an enlarged scale, of the sliding apparatus for applying the adhesive materials. *A, A*, the framing of the machine, upon which is mounted the main shaft, *B*, carrying the several cams by which the different movements of the machine are effected. The shaft is driven by the fast and loose pullies, *C*, from a steam engine or other convenient first mover. The vertical rod, *D*, which moves in the guide-frame, *D', D'*, carries upon the top of it a platform or table, shown in dotted lines, in fig. 1, at *D²*; upon this table are placed a number of envelope papers to which the adhesive material is to be applied; these papers are previously cut to the desired size and shape, suitable to be afterwards folded to form the envelope. When placed upon the table, *D²*, they are retained in their proper situation and prevented from shifting, by means of several projecting pins or studs, between which the envelope papers are placed. A vertical rising and falling motion is given to the table and envelope papers upon it, by means of the cam, *E*, upon the main shaft, *B*, which acts upon a bowl or truck upon a bell-crank lever, *E¹*, one arm of which passes into a slot in the rod, *D*, and thereby communicates a rotary motion to it, and the table upon it, and which, of course, takes place only at the proper time. At the back of the machine, at *F*, is placed the apparatus for applying the adhesive material to the envelope papers. This is shown upon an enlarged scale at figs. 3 and 4; *d*, is a plate which carries the apparatus, and slides in suitable guides upon the top of the machine at *F*, fig. 1, there being a projecting part of the framing, *A*, for that purpose. It consists of a short cylinder, *c*, secured to the plate, *d*, and within this is fitted another cylinder, *a*, the vertical position of which, within the cylinder, *c*, can be adjusted by a rack and pinion. The bottom end of the cylinder, *a*, is closed by a sponge, or other similar ma-

Fig. 2.

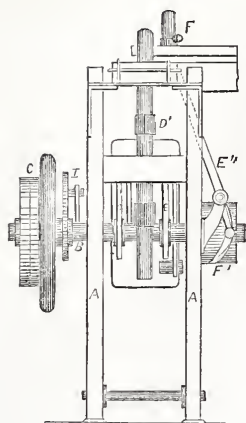
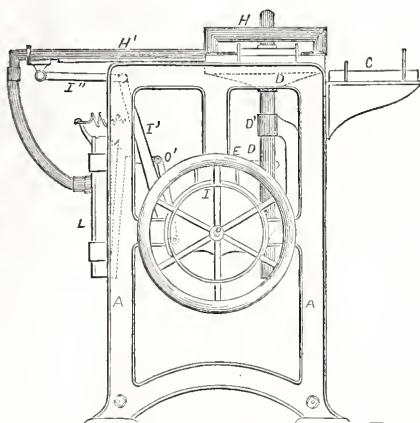


Fig. 1.



terial, *b*, forcibly inserted within it, and water is contained in the cylinder, *a*, above the sponge, by which it will be constantly kept in a wet or moist state. In front of the water cylinder, upon the plate, *d*, is placed the box, *e*, containing the adhesive material. This box fits into a recess in the plate, *d*, and a spring attached to the outside of the plate, *d*, constantly exerts its power to keep the box up to one end of the recess. There is a lug or projection, *g*, upon the end of the box, which, acting upon serrations or notches in a side bar, attached to the framing of the machine, effects a shaking of the box upon its traverse from the table, *D*², and as the bottom of the box is perforated, or made of fine wire gauze, the adhesive material will be shaken through. In front of the box are placed the brushes, *f, f*, which are for the purpose of sweeping off the superfluous adhesive materials from the envelope papers. The requisite traversing movement is given to this apparatus by means of the cam, *F*¹, upon the end of the shaft, *B*, acting through the lever, *F*², attached to the underside of the sliding plate, *d*. The curvature of the groove in the cam is such as to effect the requisite movement of the apparatus at the proper time. The traversing apparatus for removing each envelope paper, immediately after the application of the adhesive material has been effected from off the table, *D*², and depositing it upon the table, *G*, consists of the hollow bridge piece, *H*, to which is attached the

horizontal pipe, *H*¹. The lower surfaces of this bridge piece are made flat, and each has a perforation or opening into the interior; these surfaces correspond with the two end flaps of the envelope paper. The horizontal pipe, *H*¹, slides in grooves, so that it can be traversed to and fro in such manner that the hollow bridge-piece, *H*, will pass from above the table, *D*², to above the table, *G*, and back. This is effected by means of the cam, *I*, acting upon a bell-crank lever, *I*¹, upon the shaft *B*, and connecting rod, *I*². The horizontal pipe, *H*¹, is connected by a flexible pipe to the bellows, *L*, and this is worked by a cam, *O*, upon the shaft, *B*, giving motion to a bell-crank lever, *O*¹, which is attached by a connecting rod to the back of the bellows.

The action of the machine is as follows:—The envelope papers are placed upon the table, *D*², and the machine set in motion,—the table is then in its lowest position; the apparatus, *F*, is first traversed by its cam into a position above the table, *D*², and then for a time remains stationary. The table now rises, by which the upper of the envelope papers upon the table will be brought into contact with the wet sponge in the water cylinder, *a*. This part will be the seal flap of the envelope, which will be wetted. The apparatus, *F*, is then withdrawn, and as the box containing the adhesive material in powder passes above the part of the envelope paper wetted,

Fig. 3.

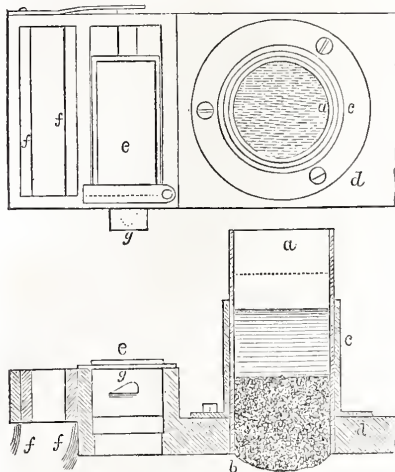


Fig. 4.

it will be shaken, and a portion of adhesive material will be deposited; all the superfluous quantity will be swept off by the brushes into a box or receptacle provided for it. When the apparatus, F, is traversed back, the atmospheric apparatus comes into action; the action of the bellows causes a partial vacuum in the hollow bridge-piece, which thereby causes the top one of the envelopes to adhere to it by atmospheric pressure, and the traverse of the apparatus carries it away, and deposits it upon the table, G, whence they may be removed at pleasure. The adhesive material being applied in a dry state, less of it is required, and the flaps will not adhere when folded together.

“ON THE FORM OF SHAFTS AND AXLES.”
BY THOMAS THORNEYCROFT, OF WOLVERHAMPTON.

The author of this paper being a manufacturer of railway axles, has had his attention drawn to the subject of the form of axles for some considerable time; and from his knowledge of the properties of iron, and his observations of the fractures of shafts and axles, has concluded that various forms of shafts and axles possess elements of self-destruction—that the fractures which take place are generally confined to given parts, and that those

parts where fracture takes place, exhibit errors of mechanical construction, or errors of mechanical arrangement, when in motion.

A very extensive course of experiments has been gone through by the author, approximating as closely as possible to the forces on axles when in use; and these have satisfied his mind, that just in proportion as there are departures from certain fixed principles of construction in either shafts or axles, in the same proportion will be their liability to fracture.

Before passing to an examination of the experiments, it may assist to a more correct elucidation of the subject, if the railway axle is viewed as having certain relations to a girder in principle. Girders generally have their two ends resting on two points of support, and the load is either located at fixed distances from the props, or dispersed over the whole surface: just so with the axle; it has its points of support and its loaded parts; but it is not clearly evident which are the loaded parts and which the props. It has been stated that the wheels may be considered the props, and the journals the loaded parts; but it is thought that with equal propriety the journals may be considered the props, and the wheels the loaded parts; if this latter opinion is at all admissible, we then have the load brought much nearer the centre of the axle than in the case where the journals are considered the loaded parts; and, besides, it brings more immediately before us the influence which the inclined bearing surface of the wheels will necessarily have in increasing the power of any lateral or vertical blow, which the axle will receive through the wheels. It is found that the inclined surface of the wheel tire ranges from 1 in 12 to 1 in 20, and, as a matter of course, the direct tendency of the wheels under a load is to descend that incline, so that every vertical blow which the wheels may receive is compounded of two forces, viz.:—the one to crush the wheels in the direction of their vertical plane, and the other to move the lower parts of the wheels together; it will be seen that these two forces have a direct tendency to bend the axle somewhere between the wheels; should that yielding or bending extend no farther than one-half the elastic limit, if long continued, fracture will ultimate-

ly take place; but should the elastic limit be exceeded, the axle takes a permanent bend, the wheels are then diverted from their vertical plane, and, as a matter of course, leave the rails. To demonstrate this is the object of the first experiment. An axle reduced in the middle to $1\frac{3}{4}$ inch dia. was placed upon two props 4 feet 9 inches apart, and loaded in the middle, the utmost of its deflection without a permanent set, was .232 inches, the load carried 7 tons. An axle reduced to 4 inches in the middle, and then placed upon the props 4 feet 9 inches apart, its utmost deflection without a permanent set was .281 inches, the load carried 9 tons. Another axle, but parallel, $4\frac{5}{8}$ inches diameter, was placed upon the props 4 feet 9 inches apart, its utmost deflection without a permanent set, was .343 inches, the load carried 14 tons. Hence, by reducing an axle of $4\frac{5}{8}$ ins. diameter in the middle to $3\frac{3}{4}$ inches, its limit of elasticity is reduced from .343 inches to .232 inches, and the load, to produce that elasticity, from 14 to 7 tons.

Fig. 1.

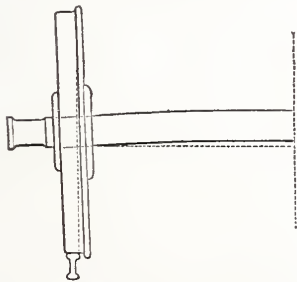
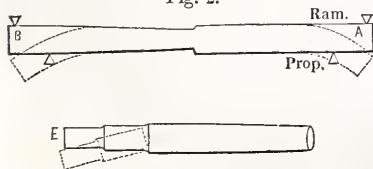


Fig. 1. shows the position of the wheels to the rails when the bending of the axle has exceeded its elastic limit.

The object of the second experiment was to ascertain what influence the reduction of an axle in the middle would

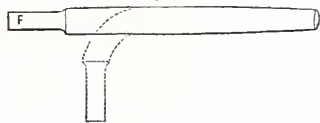
Fig. 2.



have on its strength to resist sudden impact, compared to an unreduced one; this

axle was made as represented by fig. 3, which shows the end A parallel to the centre $4\frac{1}{2}$ inches diameter, and the end B is drawn down from the back of the wheel towards the centre, where it is 4 inches diameter. The end A was then

Fig. 3.



subjected to impact—the relative position of the prop and ram was the back of the wheel and the neck of the journal, this end reciev 46 blows of the ram, and bent to an angle of 18° . The end B was then subjected to impact—the prop and the ram in the same relative position, when it bent back to an angle of 22° with only 16 blows of the ram (as shown by the dotted lines in fig. 2). The object of the third experiment was to ascertain what influence a shoulder behind the wheel would have on the strength of the axle at that part, compared to one without a shoulder. Fig. 3 and 4 were one axle cut in two, and the end E was turned from the neck of the journal, leaving a shoulder $\frac{1}{8}$ th inch deep as a stop to the wheel; the end F was turned from the neck of the journal to the same diameter, but no shoulder left. The end E was subjected to hydraulic pressure, the load being in a direct line with the shoulder, when it broke in two with a load of 60 tons. The end F was subjected in the same way to hydraulic pressure, when it bent into the form shown by the dotted lines, with 84 tons. The object of the fourth experiment was to ascertain what influence the position of the wheel, in relation to the neck of the journal, would have on the strength of the journal under impact. Fig. 5 was a piece of an

Fig. 4.



axle with a journal taken down at each end; the end G was keyed into a cast iron frame, the face of the frame in a line with the neck of the journal, the journal was then subjected to the impact of a ram falling 10 feet, when it broke off at

the 7th blow. The end H was keyed into the cast-iron frame in the same way, but with the neck of the journal projecting $1\frac{1}{2}$ inches from the face of the frame, the journal was then subjected to the impact of the same ram falling 10 feet, when it broke at the 24th blow.

From these experiments, and from the acknowledged deteriorating influence of vibration or bending on iron, especially when continued any great length of time, it is the author's opinion that neither shafts nor railway axles ought to be reduced in the middle, but rather, if there is to be a departure from the parallel form, they should be made thickest in the middle, and thus effectually prevent any vibration or bending whatever; for it is the introduction of this principle into almost every description of beam and girder, also into the connecting rods of every description of steam engine, and into a large quantity of the shafting now in use, that has rendered the whole of these articles so superior in point of durability, to what they were when other principles of form were in use.

Mr. Thorneycroft gave a further illustration of the paper by reference to several specimens of axles which were exhibited to the meeting. Having obtained an axle which had a shoulder at both ends, he turned the shoulder off one end but left it on the other, and he found that in the instance where the shoulder was turned off, it required a pressure of 120 tons to break it, and $1\frac{1}{2}$ inch deflection; while the other end, where the shoulder was not turned off, it broke with a pressure of 105 tons and $\frac{7}{8}$ of an inch deflection.



PROSSER'S IMPROVEMENTS IN MACHINERY AND APPARATUS FOR MANUFACTURING METAL TUBES.

The improvements as described in the specification consist:—

First—Of apparatus applicable for the purpose of planing and preparing the edges of flat metal plates, which are afterwards to be formed into tubes or pipes.

Secondly—Of a means of bending and turning up the flat metal plates to the form of cylindrical tubes or pipes.

Thirdly—Of preparing machinery for actuating and working the bending or turning machinery, for bending the plates.

Fourthly—Of a means of securing metal tubes into plates of steam boilers, or other vessels.

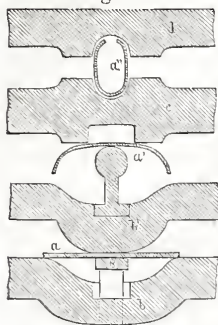
The improvements described under the first of these heads consist in certain additions to planing machinery, for planing and cutting the edges of flat metal plates, preparatory to their being formed into cylindrical tubes or pipes. In the original planing machinery, the flat metal plates,—the edges of which have to be planed and prepared,—are placed upon the horizontal traversing table of the planing machine, and properly secured thereon, the edges of the plates slightly overhanging or projecting beyond the sides of the table,—and in this position the edges were planed, and cut by fixed and stationary cutting tools.

The improvement consists in placing and securing the plates to be planed upon a traversing table upon their edges, in vertical positions, in two rows, parallel with each other, one row upon each side of the machine, and secured by one long wedge, acting upon block pieces, pressing against the sides of the plates. The uppermost of the edges of the plates upon the table being planed by the compound cutting tools of the machine, are then reversed in their positions upon the table, and their other edges planed and prepared.

The improvements under the second part of the specification consist in a means of bending and turning up flat metal plates into the form of cylindrical tubes or pipes. The means formerly in use consisted in bending up the plates by the employment of moulds or dies, of different forms, by which the plates are bent up at three distinct operations, as many pairs of moulds being employed. The first of these operations consist in submitting the flat plates to the action of a pair of moulds, by which the flat plates will assume a trough or gutter-like form; this is the first stage. At the next operation, or second stage, the plates assume a form nearly approaching to the cylindrical form; and at the third or last stage of bending, the plates assume the perfect form of a cylinder, but each of these operations are conducted separately and distinctly. The present improvements consist in so arranging and constructing the machinery, and placing the moulds or dies one above the other, that the three operations are conducted simultaneously,

and at one rise of the pressing machinery.

Fig. 1.



The annexed engraving fig. 1, shows the arrangement of the moulds, and their mode of operation, the moulds being shown in transverse section; *a*, the flat metal plate, to be bent or turned up; *b*, the lower half of the first mould, or that in which the first stage or

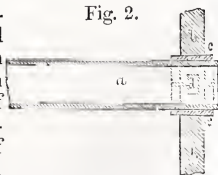
operation of bending the plate is performed; and *b'*, the upper half of the same mould. The ascent of the lower half, *b*, of the mould, and its closing upon the upper half, effects the first stage of the bending of the flat plate, *a*, which takes the form of the mould, as shown at *a'*, which is a section of the plate after the first stage of the bending is performed. It is here placed in the mould in which the second stage is performed, the upper surface of the block or mould, *b'*, forming the under mould of the second stage, and *c*, the upper half of that mould. To the lower half of this mould, *b'*, is fixed the vertical bar, *c'*, the upper end of which is of the cylindrical or bead form shown, the diameter of which is a little less than the interior diameter of the tube or pipe, when produced from the plate. The upper half of this mould, *c*, has a recess, into which the cylindrical top or edge of the bar, *c'*, is received upon the closing of the moulds, and which effects the second stage of the bending of the plate, when it assumes the form shown at *a''*, in the third mould of which the upper surface of the block *c*, forms the lower half, and the under surface of the block *d*, the upper half, and the recess in the mould, when the two halves are together, form a circle in their cross section. The plate, in the form produced from the second stage of bending, being placed, as shown, in the mould for effecting the third stage, is then, by the closing of the halves of the mould formed into the cylindrical form, and the two edges brought together into close contact; *e*, is a longitudinal bar, supported by springs and beating up against the underside of the block, *b'*, for the purpose

of maintaining the flat plate, *a*, in contact with the underside of the block, *b'*; the pressing power employed is applied to the underside of the lower block, *b*, and effects the closing of the three moulds at one and the same operation, when three plates are each forwarded one stage of the operation. Upon the descent or opening of the mould, the plates are removed, and the operation repeated upon others, or the same, until they assume the cylindrical form of tubes, when they are welded up in the customary manner.

The improvements described under the third head consist in the machinery and apparatus for effecting the pressing operations. Steam pressure is employed for this purpose, but it operates through the medium of hydrostatic or hydro-mechanical apparatus, as follows:—A large steam cylinder is provided with a piston, to the rod of which is attached the plunger or piston of a hydrostatic cylinder. From this cylinder a pipe communicates with the hydrostatic cylinder of the pressing apparatus, the ram or plunger of which is attached to the moulds for bending the plates. At one stroke of the steam piston, the piston or plunger of the hydrostatic cylinder attached to it forces a quantity of water from that cylinder, and injects it into the cylinder attached to the pressing apparatus. This quantity is just sufficient to produce the closing of the moulds, and effect the bending of the plates. Upon the return stroke of the steam piston, and the consequent return of the piston or plunger of the hydrostatic cylinders to their former positions, the water previously injected into the hydrostatic cylinder of the pressing apparatus will return back from that cylinder to the hydrostatic cylinder attached to the steam cylinder, and thereby allow the ram or plunger in it to descend and open the pressing moulds, and allow the bent plates to be removed; this return of the water through the pipe of communication takes place, because there are no valves or cocks in that pipe to prevent it.

The improvement described under the fourth part consists in an improved mode of securing tubes into the plates of steam-boilers and

Fig. 2.



other vessels. This is illustrated in fig. 2, which shows a section of the end of a tube secured into a plate; *a*, the tube; *b*, the tube plate, into which it is fixed. The hole or aperture in the plate, through which the tube passes, is made larger than the external diameter of the tube, and in the interval of space between them is inserted the conical or taper hoop or ring, *c*, the inner surface of which is cylindrical, the same as the tube, and the outer surface is conical, as is also the hole or aperture in the plate. The hoop or ring, *c*, is split or cut open at one side, and a tongue or piece of metal inserted, as shown at *d*. This is to allow a little contraction of the hoop to take place upon being driven up, and thereby to fix the tube securely in the tube plate.



GUTTA PERCHA TUBE JOINTS.

Gutta Percha fulfils no more useful office than that of a material for tubes of nearly all kinds; and as its adoption in this way is becoming universal, we have thought a few illustrative notes on the most approved plans of making the joints

Fig. 1.



may not be out of place here. Fig. 1 exhibits a method to be used for straight tubes. The two ends of the tubes are to be placed in boiling water, until they expand to the bell form shown in the figures. All moisture is then to be wiped off, and the expanded portions are to be flattened out by gentle pressure, so as to turn them into regular flanges at a right angle to the axis of the tubes. These flanges are then to be nipped together with the thumb

Fig. 2.



and finger, as in fig. 2, which is all that is necessary to form a strong joint; or if the greatest security is demanded, the surfaces may be rubbed with naphtha. When the junction is effected, the flange may be pared down to about half size if necessary. In

Fig. 3.



fig. 3 another plan is given, wherein the junction is accomplished by the insertion of a short piece of tube between the two ends.

After softening as before, the ends are to be enlarged in bore by a small iron tool. The surfaces are then to be dried, and a short piece of tube, of the length of the diameter of the ends to be joined, is to be inserted between them. The ends are then to be brought into contact and sealed with a warm iron, which experience has told us must not be too hot.

Fig. 4, is a section of this joint as finished.

Fig. 4.



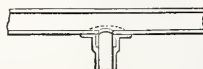
In making an elbow joint the two ends are to be cut at the proper angle, as indicated by the diagonal line in fig. 5.

Fig. 5.



These angular ends being then heated, are to be brought together accurately, but with a gentle pressure, to avoid raising a burr in the inside. The outer edges may be pinched together, and a plunge in cold water cools and completes the joint. The seam may be strengthened by attaching a thin slip of softened gutta percha round the joint. If a small tube is to be connected to a large one—say at right angles to it—an opening is to be cut in the side of the large tube, sufficient to receive the smaller one—a piece an inch long is then cut from the small tube, the end being formed to a curve to correspond to the line of junction, and this is applied, in a warm state, to the orifice, with gentle pressure, the burr being kept down in the interior by a mandril. The end of the main length of small tube, being warmed, is expanded, and passed over the short junction piece, leaving a good flange all round, as in fig. 6. This

Fig. 6.



is then pressed whilst hot, the edges being wiped down with a hot iron. If the calibre of the tube is large, it will be sufficient to cut a concave opening and convex end only, joining these surfaces by heat. Fig. 7 shows the mode of joining a gutta percha tube

Fig. 7.

to a metal one.



The gutta percha is softened in warm water, and stretched over the end of the metal tube, constant-

ly pressing the gutta percha until it cools. This is all that is necessary to insure a good joint, as the contraction of the gutta percha gives an excellent hold upon the metal.

THE AUTOGRAPHIC PRESS.

Messrs. Waterlow & Sons, the lithographers, of London Wall, are the inventors of, and are now introducing, a method of printing copies of MSS., drawings, or designs, simple and manageable enough to be within the reach of ordinary business men, or counting-house clerks. Ordinary lithography, although invaluable for most purposes where great quantities of impressions, from one original, are required, can only be practised by skilled lithographic writers and printers, and is quite beyond the power of non-professionals. It is, then, to give every individual copyist a means of multiplying the productions of his pen or pencil, that Messrs. Waterlow have addressed themselves, with an amount of success which, to those who comprehend the difficulties of the pursuit of the lithographic art, appears somewhat wonderful.

The process of taking copies of any circular, letter, piece of music, or pen-and-ink sketch, is very simple. The subject to be printed, is first written or drawn on autographic paper with autographic ink: the paper is then wetted on the back and laid face downwards on the plate, and the tympan or cover being laid over it, the pressure is easily applied by means of a scraping-bar grasped firmly with both hands. This pressure forces the moisture through the autographic paper, and causes the composition with which it is prepared to leave the paper and adhere to the plate, and with it the autographic ink, which having an affinity with the metal of the plate, adheres so firmly to it, that the composition may be washed off the plate with a wetted sponge, leaving the subject transferred to the plate. A preparation is now applied which etches the plate, and prevents it from taking the ink where it is not required. This preparation is wiped off with a damp cloth, and the inking-roller being passed over the plate, the subject becomes charged with ink, and the paper on which it is intended the copies should be taken, being laid on the plate, the tympan is placed down and the pressure

applied as before. One impression being taken, the plate is again damped with the cloth, and charged with ink, the paper laid down as before, and in this manner thousands of perfect copies may be printed.

The novelty in this invention consists in the printing-press being reduced to the simplicity of a metallic plate, and its tympan, which fastens itself on the table at which the work is performed—the materials being somewhat similar to those employed in lithographic printing.

The patentees also claim other methods of taking copies of any document; but as these require a peculiar and more complicated form of press, and consequently will not become of such general use, we need not proceed to describe them.

The credit of the invention rests principally upon the means adopted for bringing lithographic printing into more general use in the production of duplicates on a small scale. We have seen some excellent specimens of the work printed by the process just described, and printed well—some at the rate of 50 impressions an hour. One is a bold sketch of river scenery, with foliage and buildings, executed in a broad expressive style in chalk. Another is a sheet of music. All are clearly printed, and, so far, are good evidences in favor of the autographic system. If the details can be sufficiently easily managed to admit of the student, the traveller, or the man of business, producing copies at once, as they may be wanted, without a lengthened amount of practice, the invention may be considered as the greatest value.

WHITWORTH'S WORKSHOP MICROMETER.

An instrument for measuring bodies with a very minute degree of accuracy. It consisted of a strong frame of cast iron, at the opposite extremities of which were two highly finished steel cylinders, which traverse longitudinally by the action of screws one-twentieth of an inch in the thread; these screws were worked by two wheels, placed at opposite extremities of the frame, the larger of which had its circumference divided into five hundred equal parts; the ends of the cylinders, at the places where they approach each other, were reduced to about a quarter of an inch, and their hemispherical ends were highly polished. To measure with this

instrument, the large circle was brought to its zero, and the body to be measured being placed between the cylinders, the small circle was turned until the two cylinders touched the opposite sides of the body, which being removed, and the large circle turned until the ends of the two cylinders were brought to touch, the turns and parts of a turn required for this gave the breadth of the body which had been interposed, to the ten-thousandth part of an inch, and since the one-tenth of one of the divisions could be readily estimated, the size of the body could be thus estimated easily to the one-hundred thousandth part of an inch. In the accuracy required in modern workshops, in fitting the parts of tools and machines, the two-foot rule heretofore in use is not by any means accurate enough; his object was to furnish ordinary mechanics with an instrument which, while it afforded very accurate indications, was yet not very liable to be deranged by the rough handling of the workshop; and he conceived this instrument secured those advantages. It is surprising to find how very minute a portion of space could be by it, as it were, felt. By it the difference of the diameters of two hairs could be rendered quite palpable.

From the Franklin Journal.

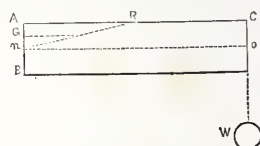
ON THE STRENGTH OF TIMBER.

BY HERMAN HAUP, ESQ., C. E.

About twelve years ago I became very much interested in calculations upon the strength of materials, but my location at that time—as an engineer on a small railroad in the interior of the state—not affording me facilities for consulting any of the standard writers whose works might have thrown light upon the subject, I had recourse to experiment and observation, in order to satisfy myself in reference to the mode of distribution of the strains, and to determine the formulæ for calculating their intensities. A little reflection led to the application of a principle, which appears to be different from any that has been employed by others, for the determination of the ordinary algebraic expressions which represent the strength of different forms of beams, and appears so simple and easy of application, and at the same time so readily deduced from the elementary conditions of resistance, that

I will take the liberty of troubling you with a brief explanation of the principle itself, and its application to some of the ordinary cases which occur in practice.

The first fact which has been established in the resistance of beams laid horizontally upon two supports, or fixed at one end and loaded with a weight applied at the other, is, that the fibres on one side are compressed, and on the other side extended. It is also a consequence of the elasticity of the material, that within the elastic limits, the resistances to extension and compression must be sensibly equal, and that a certain line exists, called the neutral axis, along which neither extension nor compression will be found, and which retains its natural condition. It is also evident that, in a material which is perfectly homogeneous, the strains upon the fibres will vary uniformly from the neutral axis to the most distant fibres. These conditions naturally lead to the following mode of calculation:



Let $A C$ represent a beam fixed at A , and loaded with a weight, w , applied at C , $n o$ represents the neutral axis. The fibres on the side, $n A$, will be extended, and those on the side, $n B$, will be compressed, and their resistance must be sufficient to keep in equilibrium the weight, w .

If $A B C$ represents a section of the beam by a vertical plane, we may conceive the strain upon the fibre, $A C$, or its equivalent resistance, to be represented by some line, $A R$; and as the strain at n is nothing, and is supposed to vary uniformly from n to A , it follows, that if n and R be joined, forming a triangle, the strain upon any intermediate fibre will be represented by the corresponding perpendicular of this triangle, and the whole strain, equal to the sum of all the perpendiculars, by the area of the triangle. The effect of this triangle of resistance would be equivalent to its whole area concentrated at its centre of gravity, and acting with a leverage equal to the distance of this point from the neutral axis.

This principle furnished a key to the solution of all the problems which are presented in calculations upon the strength of materials; it was found to be susceptible of general application. Some of the solutions require the aid of calculus, but in general they are extremely simple. The case of a rectangular beam fixed at the end will serve as an illustration.

Let the maximum strain upon the fibre A c be represented by R. Also,

b = breadth of beam in inches.

d = depth of beam in inches.

l = length in inches.

w = weight applied at c.

The area of the triangle A R n = $\frac{R d}{4}$.

The distance G n = $\frac{1}{3} d$. The effect of the triangle of resistance will be $\frac{R d}{4} \times \frac{d}{3} = \frac{R d^2}{12}$.

The resistance of the fibres n B will be also equal to $\frac{R d^2}{12}$, and the whole resistance will be $\frac{R d^2}{6}$.

The effect of the weight w , acting with a leverage l , will be $w l$, and the equation of equilibrium will be $\frac{R d^2}{6} = w l$.

In this expression the breadth of the beam has not been introduced, the calculations having been made upon a vertical section, but if the breadth be considered, the triangle becomes a wedge, and the centre of gravity remaining at the same distance as before, the only change in the expression results from the introduction of this term, and it becomes—

$$\frac{R b d^2}{6} = w l, \text{ or } R = \frac{6 w l}{b d^2},$$

An expression which is identical with those obtained by Tredgold and others by different processes.

If the beam should be placed in such a position that the diagonal of the cross section would be vertical, the solid which would represent the resistance would become a triangular pyramid, instead of a wedge as in the case just considered.

If the resisting material should be in the form of a cylinder, the case would present greater difficulty, but is susceptible of solution on precisely the same principle, the solid of resistance in this case being an ungula.

CALCULATION OF THE POWER OF CENTRIFUGAL FORCE.

To the Editor of the London Artizan :

SIR,—In your June number, in the Key to Mr. Bourne's Catechism a rule is given for calculating the bursting strain of revolving bodies, and takes the case of a fly-wheel 10 feet diameter, velocity of rim being 60 feet per second, the centrifugal force, or bursting strain, of which is said to be 2214 lbs. Now, if this be really the bursting strain, the pressure on each square inch of section is 1107 lbs., and not 553½, for the case is analogous to a steam boiler 10 feet diameter, and 1 inch thick, with a pressure of 18.45 lbs. per square inch above the atmosphere.

In it there is $120 \times 18.45 = 2214$ lbs. on every inch in length tending to burst; giving, as in the wheel, 2 square inches to support that pressure, or 1107 per inch. But I think, although that is the general rule for calculating the centrifugal force of a fly-wheel, that it gives a result just double what it ought to be.

Let us suppose that the wheel is cut in two, and the metal of one-half formed into a ball on the end of a rod 5 feet long, and revolving in a circle 10 feet diameter, with a velocity of 60 feet per second. The centrifugal force would be

$$\left(\frac{60}{4.01} \right)^2 \times 48.48 = 1107 \text{ lbs.}$$

Now this would be an unbalanced force, continually tending to break or bend the shaft about which it revolves. But again, let us suppose that the rod be extended 5 feet in the opposite direction, and the other half of the wheel be made into a ball and placed at the same distance from the centre as the other, then will its centrifugal force be equal, and acting in the opposite direction. There will then be no tendency to break or bend the shaft, as the two forces being equal, balance each other; and although the rod has a force of 1107 lbs. at each end, pulling in opposite directions, the whole strain on the rod is only 1107 lbs., or one of those forces.

This reasoning in its simplest form would be, in the case of a rope over a pulley, with an equal weight at each end, the strain on the rope being equal to only one of these weights.

From this I infer that the bursting, or centrifugal force of the fly-wheel in question, is 1107 lbs., instead of 2214.

I am, yours, truly, N. D.

[Strictly speaking, a wheel, or any other symmetrical body in which the axis of rotation coincides with the geometric axis, has no centrifugal force; for the mass of the body being equally disposed around the axis, the centrifugal force of each particle is balanced by an equal and opposite force. We may, therefore, consider the body as divided into two equal masses, having each a centrifugal force, equal and opposite to that of the other, and therefore exerting no force upon the axis of the body. Either of these masses, however, will fly off from the centre so soon as its centrifugal force exceeds the cohesive force which retains it in its place; and hence, at the moment of bursting, the cohesive force is equal to the centrifugal force of half the body. The bursting strain is not in any way affected by the circumstance, that two equal forces are acting in opposite directions, for the case is similar to that of two men of equal strength pulling at either end of a spring balance, where it is clear that the extension of the spring is precisely the same as if it were attached to any immovable object, and pulled by one man only.—*Ed. Artizan.*]

To the Editor :

SIR,—In the Civil Engineer and Architect's Journal, page 188, of Volume XI., 1848, I find a notice of a method of uniting bar and cast-iron as well as other metals or alloys, communicated by a founder in Hamburgh.

I have seen cast-iron united with cast-iron, but was not aware that it could be done with wrought-iron. Can any of your correspondents inform me as to the practical value of this process? I copy the directions as given by the inventor :

"To unite Bar-Iron to Cast-Iron.—In order to unite bar-iron to cast-iron—to make, for instance, a bar of rectangular girder, of which one-fourth the thickness shall consist of bar-iron, and the three other parts of cast-iron, or rather in the combination of one volume of these metals in any proportions, I proceed as follows:—I take a bar of iron, of the required thickness, and I plunge it into a cleaning bath composed of nitric acid or any other acid diluted with water. I then take it out of the cleaning bath, expose

it to a red heat in a furnace, and plunge it again into the cleaning bath; by means of these operations, I get rid of all the oxide from the surface of the metal. To remove from this bar any acid which might remain, I wash it with any alkaline solution (for instance, sal ammoniac), and I immediately plunge it into a bath of melted tin, where I allow it to remain until it has become well tinned over its whole surface. This done, I apply to the tinned iron at the side, where it is to be united with the cast-iron, an alloy or solder composed of copper and tin, in the proportions of five parts of copper and ninety-five of tin. The bar of iron thus prepared is then introduced to the bottom of a mould of the form and dimensions corresponding to the bar which it is wished to be produced, and it is kept down by iron bolts or nails, which have previously been well tinned; the cast-iron is then poured in a liquid state on the bar of iron, until the mould is filled. In this state, a fusion takes place at the surface of the iron in contact with the liquid cast metal, and under the influence of the alloy of solder of copper or tin interposed, the two pieces of bar-iron and cast-iron unite so firmly the one to the other, that it is almost impossible to separate them.

"To unite Steel with Cast-Iron.—Follow exactly the same process as above described.

"To unite Copper, Bronze, Gun-Metal, or Brass, with Cast-Iron.—These alloys, as well as all those of copper, can be united by exactly similar means to those above described; except that instead of clearing the surfaces of the alloys by means of acid and alkaline solutions as above mentioned, the surfaces should be filed, and the union with the cast-iron effected at the lowest temperature possible, in order that the bar of alloy might not be melted.

"The proportion indicated above for the composition of the alloy or solder, is that which appears the most suitable, where the pieces of metal to be united are of moderate dimensions; but when they exceed moderate dimensions, it will be better to increase the proportion of copper employed.

"In the examples given above, it is supposed that the different metals were united together on one side only; but one of these metals may be united at two sides, or at two opposite or adjacent faces, to the other metals, or even covered throughout its entire surface. Further, the pieces of metal may have a curvilinear, angular, or any other form, and the manner of moulding may be varied according to the rules which practice has long since furnished in foundries."

The following article, originally published in De Bow's Review, has been revised by the author for this Magazine:—

PROTECTION OF THE LOW LANDS OF THE MISSISSIPPI.

BY BREV. MAJ. J. G. BARNARD, U. S. ENGINEERS.

This subject is an extensive one, and I have only been able to spare the time to give it a superficial study; but, as the data we have to base our conclusions upon are very imperfect, it would be a waste of time to make them the basis of very extensive and nice computations. I believe that the various phenomena of the Mississippi can be subjected to accurate calculation with almost the same nicety as the running of water in a pipe, were the requisite data obtained. Such data can only be acquired by a long series of observations. They should be carried on by observers stationed at different points from the mouth to the northern limits of the State, at least, and should be extended through several years. In addition to this, some knowledge of the river, up as far as the mouth of the Ohio, is necessary, and all the principal tributaries should be studied, so as to ascertain the periods and durations of their floods, the effect which each, individually, produces upon the elevation of the main stream, the character of the sediment which each brings down, &c.

When a mass of data like this is collected, a safe theory of the Mississippi river can be formed, and not before. With such data as we have, we can only obtain approximate results and form general conclusions. In the following calculations, I have carried the investigation as far, I think, as it is profitable to do. I have investigated the following points:

1. How much ought the surface of the river to have been lowered at Carrollton by the Bonnet Carre crevasse, assuming the discharge of that crevasse at 37,500 cubic feet per second, as estimated by Professor Riddell?

2. How much ought the surface of the river at Carrollton to be lowered by a waste wier, at Bonnet Carre, capable of discharging (according to his estimate) 120,000 cubic feet per second?

3. How much ought the surface of lake Pontchartrain to be raised by being made the recipient of the latter volume of water?

4. What will be the ultimate effect, on the bed of the river, of discharging, by waste wiers or other lateral outlets, so large a volume of water?

5. What is the effect of the levee system on the bed of the river? Does it cause it to rise, or does it, on the contrary, have the opposite effect?

The method of Dubuat for determining the change in elevation of the surface of a river, from increasing or diminishing its waters, is—knowing the width and depth (assimilated to a rectangle) of a river discharging a known volume of water—to calculate what that depth must be (the bottom, of course, remaining unchanged), should that volume of water be increased or diminished a certain quantity. The difference between the original and calculated depths will be the amount that the surface of the river will be raised or lowered.

In making the calculation, I take the data of Professor Riddell, because I find them to be pretty consistent with theory, and in order that the results may be compared with his. They are as follows:

$D = 600,000$ cubic feet per second, the mean high water discharge.

$r =$ mean radius, or hydraulic mean depth (to be calculated).

$b =$ the denominator of the fraction expressing the declivity, which, if the river surface at Carrollton is 15* above tide, and 110 miles from the mouth, is 38,720.

$l =$ width of river, or 2,350 feet.

$h =$ the rectangular depth, assumed by Professor Riddell, in his pamphlet, at 75 feet; but, as he has since stated it to me, 78 feet.†

Now, as this latter element is to be the standard of comparison, by which the calculated elevation or depression of the river is to be ascertained, and as the observations have been too cursory to fix all the data with positive accuracy, it becomes necessary, before entering into further calculation, to subject this assumed depth to the theory, and make it consistent with the other data.

The formula of Dubuat is (modified so as to be expressed in English feet):

* This, according to Prof. Forshey, should be 17 instead of 15 feet.

† This, by the same authority, should be 71.6 feet.

$$h = \frac{D}{l(\sqrt{r-0.0288})^{\frac{88.6}{\sqrt{b}}}-0.0866)}$$

in which r , the mean radius $= \frac{lh}{l+2h}$ and $\sqrt{b} = \sqrt{b-L_*} \cdot \sqrt{b+1.6}$.

The above equation can only be solved by substitution and approximation; and, after many trials, I find $h = 79.10'$,† which will therefore be considered the original rectangular depth of the river.

Assuming, now, $D = 562.500$ cubic feet per second, which supposes 37,500 cubic feet to be thrown off, as Professor Riddell estimates, by the Bonnet Carre crevasse, the value of h must be calculated for this reduced discharge. This, as before, can only be done by supposition and substitution, and, as every change in the assumed value of h involves a corresponding change in the value of b , or the declivity, the operation is extremely laborious.

After many trials, I find 78.05 feet to satisfy, pretty nearly the equation, and this, therefore, is the new depth of the river, and the difference between this and 79.10 feet, or 1.05 ft., is the depression of surface produced at Carrollton by the crevasse, supposing it to discharge only the quantity of water estimated by Professor Riddell.

The Professor calculates this depression at 1.40', but he does not profess to use a rigorous formula, and he afterward states, that the depression at Carrollton and New Orleans may be considered as "about one foot," which is almost precisely what I have calculated.

A similar operation will determine the depression of surface, on the supposition that 120,000 cubic feet per second are thrown off by a waste wier, and the depression thus determined is 3.40 feet.

I believe these determinations are as rigorous as analysis can make them, with the imperfect data we possess. No account is taken, indeed, of the effect of the bends of the river on the velocity, but

there is but one considerable bend below New Orleans, and, as the retarding effect is pretty nearly the same for the full and diminished discharge, the errors of the formula, arising from that source, will nearly neutralize each other.

The third point to be treated is the elevation of lake Pontchartrain, by throwing into it, through a waste wier, a volume of 120,000 cubic feet of water per second. There is, at the outset, an evident inconsistency between the facts observed during the past winter and Professor Riddell's calculations. According to him, 119,370 cubic feet of water, thrown into the lake, will only raise its lower end 2.4 inches; and he estimates, at the same time, that only about one-third of this quantity, or 37,250 cubic feet per second, has actually been thrown into it, which should, of course, have raised it still less. So small an elevation would scarcely have been observed; yet it is an indisputable fact, that the lake has been constantly, since the occurrence of the crevasse, much above its ordinary level.

It is to be regretted that no accurate registers, of the level of the lake in former years, exist, by which to make a comparison. Serjeant Bosworth, who has been stationed at Fort Pike for a number of years, thinks, that the lake has been eighteen inches to two feet higher, during the last, than during previous winters, and he states that this estimate is confirmed by others. I think this is too high an estimate; that it is rather taken from observations of *extreme* differences than a fair mean, and I think one foot to be a full allowance. I endeavored to have some measurements made at Fort Pike, by which to determine the point, but the lake has been so constantly high, lately, through the effect of continued easterly winds, that the old water marks have been inaccessible.*

I have calculated the elevation of the lake required, in order to throw off, through the Rigolets and Chef Menteur passes, a volume of 120,000 cubic feet per second; or, what is the same thing, to maintain a velocity through these passes of 1.283 ft. per second. This I do by finding the value of b , or the slope which will satisfy

* Hyperbolic logarithm.

† This is the result of an assumed fall from Carrollton to the Balize of 15 feet. If the fall of 17 feet as determined by Prof. Forshey were taken as the basis of calculation, it is likely that the calculated result would correspond much more or quite nearly to his observed mean depth of 71.6 feet.

* Since writing the above the increased elevation of the lake has been determined and fixed by Mr. Brinzier at 19 inches. This disagreement with calculation, proves that our data in relation to the discharge of the lake are quite inaccurate.

Dubuat's formula for the velocity: $V = \frac{88.6}{1.283 \text{ ft.} = (\sqrt{r} - 0.0288)(\sqrt{B} - 0.0866)}$, taking the areas of the passes as estimated by Professor Riddell.

I find, by this computation, $6\frac{1}{2}$ inches to be the required elevation. I should mention, however, that, in this, I have taken the length of the Rigolets at nine miles, instead of six miles, as assumed by Professor Riddell. By a map in my office, made by the topographical engineers, this pass is over nine miles long. Latourette's map makes it about the same, and, lastly, Captain Hiern, of the Oregon, estimates it at nine miles.

This elevation of $6\frac{1}{2}$ inches is hardly sufficient to account for the observed elevation of the lake, but it is likely that this is not all the fall that is actually necessary. The lake becomes contracted between Point aux Herbes and the northern shore, at a distance of about six miles from the commencement of the Rigolets pass, to a width of only three miles; and that, between the Point aux Herbes and the entrance of the Rigolets, an extensive shoal, having but six feet of water upon it, is located. It is likely, therefore, that a considerable fall is necessary between "Point aux Herbes" and the entrance of the Rigolets. There are no sufficient data upon which to attempt a calculation. In addition to the above, Professor Riddell has calculated that a fall of nine-tenths of an inch is necessary in the lake itself. Taking all these together, it is likely that we can account for an elevation of nine or ten inches, and, perhaps, one foot, in the present level of the lake; and I am inclined to think that this is about the true *mean increased elevation* during the past winter. But, to get as much as that, we must believe that near 120,000 cubic feet, per second, of water, have been thrown into the lake, instead of 37,500. It is difficult to estimate the real quantity of water which has escaped from the river. It is stated that the river has been *two feet** lower at New Orleans than it was last year. To produce this reduction, I find that it would be necessary to throw off 75,000 cubic feet of water per second; and if, as stated, the river has been higher above than it was last year, a still greater

quantity must have been thrown off—perhaps as much as the quantity I have taken as the basis of calculation, viz.: 120,000 cubic feet.*

The elevation of the lake is not, however, a matter of such vital importance, so long as it is not permitted to exceed ten inches or one foot (though we have known it, *in its natural state*, to overflow the rear of New Orleans, from high and long-continued south-easterly winds), as the probable effects, on the bed of the river, likely to be produced by throwing off, through waste wiers, a portion of its waters. It is this point which I shall now consider.

I have shown that the throwing off of 120,000 cubic feet of water per second, would reduce the surface level of the river at Carrollton 3.4 feet. This would be the *first and immediate result*, supposing the bed to remain *unchanged*. But this result will be accompanied with a reduction of velocity from 3.227 feet per second to 2.70 feet per second.

Now, it is pretty well established, that certain relations exist between the configuration of the bed of a stream and the velocity of its current. This relation is the most clearly discernible, and capable of being subjected to calculation, in rivers (like the lower Mississippi) whose beds have been formed of materials brought down by their own currents: in other words, which have *made and shaped their own beds*.

I find this principle laid down in the work of Frisi "On Rivers and torrents," which was placed in my hands by W. S. Campbell, Esq. He quotes and confirms the rules established by another engineer, Guglielmini, which are, that "the greater the quantity of water a river carries, the *less will be its fall*," and "the greater the force of the stream the less will be the slope of its bed." And, again, "the slope of the bottom in rivers will diminish in the same proportion in which the body of water is increased," and vice versa. These rules have their explanation in the facts, that the beds of rivers, of the character above mentioned, are capable of resisting, unchanged, only a certain velocity of current; and, on the other hand, that the sedimentary matter,

* The actual discharge of the crevasse has since been a subject of investigation by Prof. Fershey, who estimates it below the lowest of these figures.

* This should be stated at 17 inches.

contained in the river water, requires a certain degree of velocity to keep it in suspension. From the counteracting tendencies of the above two causes, a mean becomes established, at which the current ceases to deposit its sediment, and the bottom ceases to be abraded; in other words, the bottom becomes permanent. But if, from any cause, such as throwing off a portion of the water through a waste wier, the velocity of the current is diminished, it is no longer able to maintain its sediment in suspension, but will continue to deposit in its bed, until, through the elevation of the bed, its velocity again becomes, what it was before it was disturbed, sufficient to maintain its sediment in permanent suspension.

Now, it is a well-established principle in hydro-dynamics, that the less the volume of water the greater the surface slope required, in order to maintain a given velocity. Paradoxical as it may appear, then, it is a certain result of the foregoing principles, that the more water we throw off by waste wiers, *after we have passed that limit at which the velocity is just sufficient to keep the bed clear*, the higher will the surface *ultimately* become. What that limit is, I do not pretend to decide. If we assume that the present velocity is necessary for that purpose, and that any diminution will cause a deposit in the bottom, then we cannot throw off a single cubic foot of the water, now necessary to maintain this velocity, without causing an ultimate rise both in the bed and surface. The fact of this rise and its amount, is as capable of rigid demonstration as any problem in mathematics.

Taking the data of Professor Riddell, I find 3.227* feet per second to be the

velocity due to a discharge of 600,000 feet per second, and a fall of fifteen feet from Carrollton to the sea. Throwing off 37,500 cubic feet, through a waste wier, would reduce the velocity to 3.066 feet per second, and, the first velocity being supposed necessary to prevent deposit, the bed and surface must rise until the original velocity of 3.227 feet is restored. From the formula, $V = 3.227$

$$\text{feet} = (\sqrt{r} - 0.0288) \left(\frac{88.6}{\sqrt{B}} - 0.0866 \right), \text{it}$$

will be found, that the fall from Carrollton to the Balize must be 15.75 feet, and that the mean depth must be reduced to 74.17 feet, in order to reacquire this velocity with the diminished discharge; or, in other words, the surface of the river will ultimately rise, at Carrollton, 9 inches, and the bed 5.78 feet.

Making the same calculation for a reduction of 120,000 feet per second, in the discharge, and it will give an ultimate increased elevation of surface, at Carrollton, of 2 feet 9 inches, and elevation of bed of 18 feet 6 inches. (In these calculations, the mean width, 2,350 feet, is supposed constant.)

It is necessary to observe, that the above results arise from the supposition that the several volumes of 37,500 and 120,000 cubic feet per second, are thrown off from the *original* 600,000 cubic feet, assumed to be the natural high-water discharge of the river, and necessary in order to keep the bottom permanent. If, however, observation should show that the floods of the river are yearly *increasing*,* and that more than the above volume, necessary to maintain the velocity of the regimen, comes down, *then* all the *surplus* may be thrown off through a waste wier, without any tendency to raise the bed; on the contrary, the evils of too high a velocity, such as the rapid abrasion of the banks, will be thus avoided. This is a matter for future observation. Nor is the above quantity of 600,000 cubic feet per second taken as absolute: it is assumed.

* This result of 3.227 feet per second is the *calculated mean velocity* at high water from the data before mentioned, subjected to Dubuat's formula. Deducting from this the *surface velocity* by the formula $v = (\sqrt{V - 0.25} + 0.5)^2$ (also from Dubuat) in which v is the surface velocity, V the mean velocity, both expressed in inches per second, we get the surface velocity to be 41.89 inches or 3.41 feet per second.

By a mean of 176 observations of the high water velocity of the river, taken at Carrollton, Professor Forshey fixed this velocity at 3.82 feet per second. The difference is not great: it is likely, however, that if the fall should be taken at 17 instead of 15 feet, as fixed by Professor Forshey, and corrections made for the retarding effect of the curvature of the river, the result might coincide still more nearly with observation.

I ought to remark that, at the time of making these calculations, I was unacquainted with the more extensive and elaborate data of Prof. Forshey, or I should certainly have availed myself of them. The public is indebted to him for the most complete and reliable data at present existing: or rather for the *only* body of observations, embracing considerable periods of time, and spread over a large extent of the river.

J. G. B.
* Prof. Forshey's records go to show that this is not the case

ed as the basis of calculation for want of a better. Prolonged observation must show the exact volume and velocity necessary for the maintenance of the regimen of the river. Any reduction of this ascertained volume, by lateral discharges, must, ultimately, raise the bed and the surface of the river; but the surplus may be thrown off with safety and with beneficial effects.

The increased elevation of the surface of a river, by diminishing its volume, paradoxical as it may appear, is not unconfirmed by observation. I had, somewhat to my own surprise, arrived at these results, by an application of well-established principles to the facts of the case; but my attention has since been directed, by W. S. Campbell, Esq., to several instances mentioned by the Italian engineer, Frisi, of such effects being actually produced from such causes.

The division of the Rhine into several branches, near its mouth—said to have been commenced by the Romans—is said to have caused a constant rising in the beds of these diminished branches. A waste wier, proposed to relieve the Leck from its surplus waters, was opposed by the engineer, Gennete, on the ground that it could have no good effect.

Two relieving sluices, made in the Celone, are said to have caused the filling up and loss of the principal trunk of that river; and it is likewise said, that the lateral discharges, made in the Adige, have only produced a heightening of the bed, and thereby rendered the floods more dangerous.

The results I have given being, as they are, rigid deductions from well-established principles governing the phenomena of rivers, and confirmed by experience, we cannot be too cautious about throwing off the waters of the Mississippi through lateral outlets, or tampering with it in any way. That a certain amount of water might be thrown off, in *extreme stages*, with safety and beneficial results, appears probable; but it is extremely doubtful whether a waste wier, into lake Pontchartrain, could be kept open. As the river commences falling, the velocity in the outlet will be checked and a deposit will form. This, during the summer and autumn, will become covered with a dense

growth of reeds, grass, &c., which would still further obstruct the discharge of the next year; so that, in a few years, there would be no other result of the heavy expenditure of making this outlet, than a strip of high land from the river to the lake.

I have but few words to say on the subject of levees. If the results I have given in this paper are correct, then the levee system, instead of favoring, as is alleged, the tendency of the bed of the river to rise, has precisely the reverse effect. By confining the waters within their limits, they increase the velocity and abrading power of the current, causing a deepening, rather than an elevation, of the bed. This velocity may become too great for convenience, causing a rapid destruction of the banks; but the tendency to prevent the elevation of the bed is not the less true. It may safely be affirmed, therefore, that the bed of the river is now lower than it would have been, had no levees been made.

If, as is probable, all schemes for relieving the river from its surplus waters, by lateral discharges, fail, then levees must remain, as they are now, our only safeguard. The great difficulty now is, that the levees are entirely inadequate to their object. A study of the levee system in Holland, where much greater heights of water, and even the waves of the ocean, are to be contended with, would give Louisianians some light as to what a safe levee should be.

The levees should be much wider and higher than they now are. The carriage road, instead of being along side, might be on their tops, which would keep them always compact and the road itself dry. When the bank is caving, the levee should be so far removed from the river as to be beyond all possibility of danger.

An efficient system of control and management should be established, so that the welfare of a whole community should not be hazarded by the negligence of an individual. With such a levee system, I think the crevasses we hear of in almost every day's paper—so destructive to property, and likely to be so permanently injurious to Louisiana, should they not be hereafter prevented—need not occur.

MINOT'S ROCK LIGHTHOUSE.

After the late severe gale (22d and 23d Dec.), the keeper of the Iron Pile Lighthouse, on the exposed coast in the neighborhood of Boston, addressed a letter to the Editor of the Boston Daily Journal, in which, either to enhance the value of his services, or taking counsel of his fears, or both combined, he has painted his dangers, past and prospective, in such strong colors, that the public in general, and Engineers and Mechanics in particular, are deeply interested in knowing something of the facts in the case.

The effect of his letter was well calculated to shake our confidence in iron as a material for lighthouses, especially for one in the exposed situation of the above. Upon application for information to the Engineer (Capt. W. H. Swift, late of the U. S. Engineers) who constructed the lighthouse, he has kindly supplied us with the following facts, which we preface by quotations from the letter of the light-keeper:—

From the Boston Journal,

MINOT'S ROCK LIGHTHOUSE,
Sunday night, 11 o'clock.

MR. EDITOR: These last forty-eight hours have been the most terrific that I have witnessed for many a year. I would fain withhold my pen, but the promise I made you compels me to send you this statement. Since last evening, at 6 P. M., we have been accompanied by a friend of mine (an attorney of your city, to whom I will, privately, if he ever reaches Boston, refer you or any one who wishes to know what this place is), who came down with little expectation of witnessing such a gale as this. It commenced as soon as he placed his foot on our deck. * * * * *

The raging violence of the sea no man can appreciate unless he is an eye-witness. Unceasingly we had been lashed with its fury, and, should the wind back again to the northeast, I fear all will be up with us.

When I engaged to keep this lighthouse, little did I think that my heart, which had never for twenty-five years, in the most boisterous regions, failed me, would tremble at any thing here; and so precarious is our present situation, that there is a prospect

that this may never reach you. The rods put into the lower section are bent up in fantastic shapes; some are torn asunder from their fastenings; the ice is so massive that there is no appearance of the ladder; the sea is now running at least twenty-five feet above the level, and each one roars like a heavy peal of thunder; the northern part of the foundation is split, and the lighthouse shakes at least two feet each way. I feel as sea-sick as ever I did on board a ship.

Think not that I will ever flinch from my post, though the waves should gain the mastery for which they are so incessantly striving. When I accepted the post I closed my ears against the reports of the former keeper, treated them (as I now find) too lightly, and here I shall remain so long as a vestige of the lighthouse remains; but the truth must be told. My report to the collector contains a more minute account of the effect the gale has had upon us. At intervals an appalling stillness prevails, creating an inconceivable dread, each gazing with breathless emotion at one another; but the next moment the deep roar of another roller is heard, seeming as if it would tear up the very rocks beneath as it burst upon us—the lighthouse, quivering and trembling to its very centre, recovers itself just in time to breast the fury of another and another as they roll in upon us with resistless force. * * * * *

Our situation is perilous. If any thing happens ere day dawn upon us again, we have no hope of escape. But I shall, if it be God's will, die in the performance of my duty.

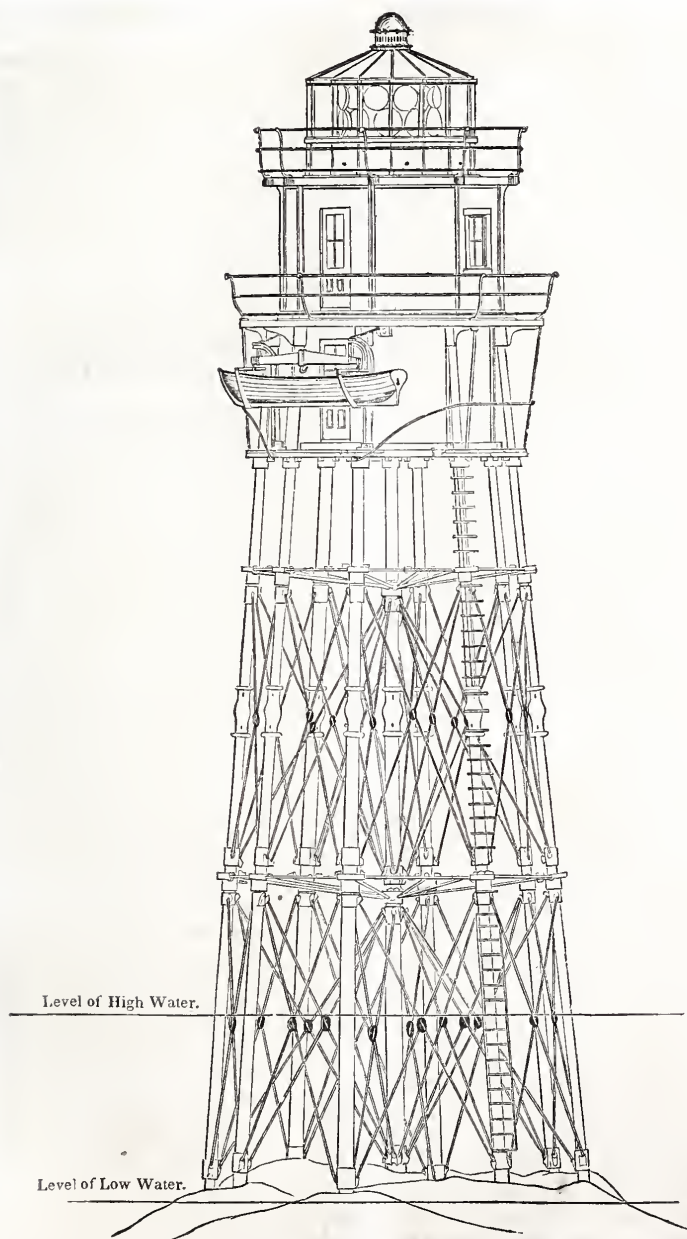
P. S.—I have put a copy of this in a bottle, with the hope it may be picked up in case of any accident to us.

JOHN W. BENNET, *Keeper.*

To the Editor of Appleton's Mechanics' Magazine :

SIR,—The Iron Pile Lighthouse on Minot's Rock, near Cohasset, has attracted some attention of late in the newspapers, in consequence of a letter addressed by the keeper of the light to the Editor of the Boston Daily Journal, and written since the gale of the 22d and 23d December last.

It has occurred to me that a brief account of this structure might possess sufficient interest to entitle it to a place in your Journal, and I inclose you a sketch of the Lighthouse, and a few notes containing a description of it, for it is very clear that the letter of the keeper, referred to above, is not calculated to in-



spire any great degree of confidence in the stability of the structure

WILLIAM H. SWIFT.

Philadelphia, Jan. 9, 1851.

The "Screw Pile Light," as it is called in England, possesses three important advantages, and notwithstanding it may not be as unyielding as a column of granite, it may, for all the purposes for which a lighthouse is required, be quite as useful. The Eddystone, the Bell-rock, and the Skerryvore Lighthouses are all lasting monuments of the genius and skill of the several Engineers who have built them, but in comparing these magnificent works with the simple and rapidly constructed screw pile light, we shall find while the latter may cost from 20,000 to 50,000 dollars, the stone columns enumerated have cost, from 250,000, the least, to 500,000 dollars, the greatest, and in point of time of building also, the comparison is equally favorable. As a practical question then, it is one of easy solution:—Shall we content ourselves with that which in point of cost is within our reach, or shall we undertake to imitate our transatlantic brethren; and for such an exposed reef as the Minot, will Congress appropriate 200,000 dollars, or more, for a stone tower, like the Eddystone, or shall we satisfy ourselves with a more simple and less costly work?

The question to be first considered is, Can such a structure as the screw pile be made safe in a situation as open to the Atlantic as is the Minot Rock, a place as fully exposed, in fact, to the fury of the sea, as the Eddystone or any other light-house existing?

Time alone can fully furnish the answer. The Minot is now in its *third* winter, and is still standing in its place, and notwithstanding the reports which from time to time have been spread that it rocks like a cradle, that buckets of water are emptied of their contents by the surging of the structure, sea-sickness of those who have battled with storms on the ocean 25 years, &c. &c., the answer is, that the light is precisely where it was placed in the autumn of 1848, and this too when it is reported by the keeper that the rock upon which it stands is "split."

But, as I have said above, time alone will tell us whether such a structure can be made to stand in such a situation.

There are two peculiarities in the Minot light.

In Great Britain there had been three screw pile lights erected when the building of the Minot was commenced. All these, however, had been built upon sands, or shoals, requiring the use of the screw; a cast-iron disc of some 3 or 4 feet in diameter; but none had been put up where the sea *breaks* with any great degree of violence; that is to say, all being in shoal water, the sea in such places *rolls*.

At the Minot, the deep water is within 50 feet of the light; consequently the sea breaks with great violence upon the rock whenever it blows fresh from the eastward.

The second peculiarity is that the screw, or disc, is not used. Holes, 12 inches diameter each, and 5 feet deep in the rock, receive the piles; these again are of wrought-iron entire, and not, as in England, of iron and timber combined.

Those who would look for as much rigidity in a structure built upon the top of nine iron poles, 60 feet high, upon a sunken rock in the Atlantic ocean, as they would look for in the Eddystone, or the Bell-rock, will not find it; nevertheless, the light exhibited to the mariner to guide him in the storm, will be quite as useful to him, whether the one or the other support the lantern. Even in the massy column of the Bell-rock light, it is well known that the force exerted upon it by the sea in a gale of wind, produces sensible vibration at the lantern. This structure is 42 feet at base, and 100 feet in height, and a large portion of it *solid masonry*.

With these remarks premised, I add the following extracts from a Report which I made in November, 1848, to the Chief of the Corps of Topographical Engineers, Col. J. J. Abert, under whose orders, and by whose directions, the Minot was built.

"Minot's Rocks, or, as they are generally designated, 'the Minots,' lie off the south-eastern *chop* of Boston bay, about seventeen miles from the city, and something less than eight miles from the Boston light.

"These rocks or ledges, with others in their immediate vicinity, are known as the 'Cohasset Rocks,' and have been the terror of mariners for a long period of years; they have been, probably, the cause of a greater

number of wrecks than any other reefs or ledges upon the coast, lying, as they do, at the very entrance to the second city of the United States, in point of tonnage, and, consequently, where vessels are continually passing and repassing. The Minots are sunk, and bare only at three-quarters ebb, and the trend of the coast in that direction from Boston bay being southeasterly, vessels bound in, with the wind heavy at northeast, are liable, if they fall to the leeward of Boston light, to be driven upon these rocks.

"The rock selected for the site of the light-house is called the 'Oter Minot,' and lies farther seaward than others in the group known as the Cohasset Rocks. At extreme low water, an area of about thirty feet in diameter is exposed, and the highest point in the rock is about three and a half feet above the line of low water. It is very rare, however, that a surface greater than twenty-five feet in diameter is left bare by the sea. The rock is granite, with vertical seams of trap rising through it.

"From observations upon the tides, made at Boston lighthouse by the coast survey, from June the 7th to October 27, 1847, the following results were obtained:—

Rise of highest tide	14 ft. 7 in.
Mean rise and fall of tides	9 " 4 "
" " " spring tides	10 " 8 "
" " " neap "	8 " 3 "

"The form of the lighthouse frame is an octagon, of 25 feet diameter at base. The structure is formed of eight heavy wrought-iron piles, or shafts, placed at equal distances from each other, with one also at the centre. These piles were forged in two pieces each, and are connected together by very stout cast-iron or gun-metal sockets, three feet long, the interior of which is bored, and the pile ends are turned and secured to the sockets by means of large steel keys passing through the piles and the sockets. Above and below the joints, or sockets, and connecting the middle pile with each outer pile, there extends a series of wrought-iron braces; and the outer shafts are connected together by similar braces extending from one to the other, and thus the whole structure is tied together. At each of the angular points in the octagon and at the centre, a hole of twelve inches in diameter and five feet in depth is drilled in the rock, the outer holes with the inclination or batter given to the outer piles, and the middle holes vertical.

"The surface of the rock being irregular in shape, and the holes in each case five feet deep, it is evident that the piles must be of unequal lengths, the least length in the lower series is thirty-five and a quarter feet; the greatest is thirty-eight and three-quarters

feet, and the others are of various lengths between them. The piles in the upper series are of uniform length, viz., twenty-five feet each, the inclination or batter of the piles towards the centre is such as to bring the heads of the upper piles within the periphery of a circle of fourteen feet diameter, and there, at an elevation of sixty feet above the base of the middle pile, or fifty-five feet above the highest point of the rock, the pile heads are secured to a heavy casting or cap, to the arms of which they are securely keyed and bolted. The middle shaft is eight inches in diameter at foot and six inches at top, and the outer shafts are eight inches at foot and four and a half inches at top. All of these are forged ten inches in diameter, at the point where they leave the surface of the rock, and taper uniformly to eight inches diameter in both directions. The lower braces, placed nineteen feet above the rock, are three and a half inches in diameter; the second series, nineteen and a half feet above the first or thirty-eight and a half feet above the rock, are three inches diameter, and a third series, introduced eight and a quarter feet below the cast-iron cap, to form the support of the floor of the store-room, is made of two and a half inch square iron.

"The outer piles being inclined towards the centre, and the piles and the braces being inflexible, it is clear that, so long as the braces remain in place, the pile cannot be withdrawn from the hole, for the whole structure acts as an immense '*Levis*;' either the braces must be ruptured, or the rock itself must yield, before a pile can be displaced.

"Upon the pile-heads are cast-iron sockets, furnished with arms three feet in length, pointing outwards. These sockets are keyed to the head of the piles, and are bolted to the arms of the cap or spider, flush with its upper surface; thus giving a diameter at top of 20 feet, from out to out. The object of the arms is to afford support for a footway or gallery outside of the keeper's house, which is placed immediately on the cap, and there secured by bolts and keys.

"The keeper's house is octagonal in shape, and 14 feet in diameter; the uprights or stanchions are of cast-iron, and rest upon the cap immediately over the pile-heads, where they are secured with bolts and keys; these uprights are cast with double flanges, between which two-inch plank, tongued and grooved, are fitted horizontally, and at right angles to these another series of plank, set on end or vertically, and, together, these form the side or frame of the house; upon this frame the roof is placed, and, finally, upon this the lantern is set up.

"The drilling of the holes in the rock for

the lighthouse occupied the better part of two seasons. The erection of the iron structure in place, it may be conceived, was comparatively a work of much less difficulty, and, with favorable weather, an undertaking requiring not much time. That some of the difficulties may be known of working down 9 holes of 12 inches diameter and 5 feet in depth, in a rock of granite traversed by veins of the most obstinate trap, in a situation exposed to the delays produced by every breeze which had *east* in it, I will enumerate briefly, from the journal of operations kept at the rock, some of the details, for future reference.

"The mode of working the holes down had for some time occupied the thoughts of the contractor, and he became satisfied that holes of the magnitude required in that exposed situation, where the sea was so continually breaking over the rock, could be drilled by machinery only, and that it would be necessary to have that machinery elevated beyond the ordinary reach of the sea.

"The drill used was of a peculiar form, with an edge in shape somewhat similar to the letter z, made of the best cast-steel, and fitted to an iron shaft some 30 feet in length, and weighing, with the drill attached, about 600 pounds.

"The machine for working the drill was a wheel and axle furnished with tooth and pinion, and a crank or windlass at each end; this was placed on a frame of stout oak, and it required the power of four men to work it effectively. A cam and a fly wheel were attached to the axle, and at every revolution the drill was raised about eight inches, and driven ordinarily at the rate of about fifty strokes per minute, the men being relieved every twenty minutes.

"To support this machine, it was necessary to erect upon the rock a triangle or shears of very heavy spars, secured at their feet by means of pintles, and chained down to Lewis bolts inserted in the rock; upon the triangle was placed a platform, and upon this the machine was worked, the drill being kept at the proper degree of inclination for the hole by means of guides, through which the shaft moved up and down; the whole arrangement answered the purpose admirably well, and the holes were cut as truly and as perfectly as an auger hole could be cut in a piece of wood.

"The triangle and drilling machine were swept from the rock twice by the sea during the first season's operations, and the men were frequently washed from the rock, but happily no lives were lost. The work was suspended at the rock on the 25th October, 1847.

"The total number of men employed in 1847, by the contractor, was 34, the average number about 21; in addition, a schooner of about 80 tons burthen was chartered by the contractor for himself and his hands to live on board of, and the vessel was kept moored near the rock at all times when she could lie there in safety, or when the weather would admit of it; by this arrangement every hour of time, in which work could be done at the rock, was rendered available.

"All the necessary preparations for the work of the present season were made early in the spring; a new triangle was provided of heavy spars, some forty-five feet in length, and strengthened by a number of very stout iron braces, and with bars of iron on each spar, extending over all that part of the triangle which was exposed to the shock of the sea.

"The holes were all finished on the 16th August; that is to say, 9 holes of 12 inches diameter, and 5 feet deep each.

"Some delay was produced in this stage of the work, by an alteration which I had decided some time earlier in the season to make, to wit: to increase both the size and the length of the lower series of piles, and this increase in dimensions produced some delay in the forging at the machine shop. The difference in size between piles of hammered iron 25 feet long and 8 inches diameter, as originally designed, and piles 35 feet long and increased* to 10 inches, involved some difficulties, and required a little more time in the fabrication than I had reckoned upon, so that it was not until the 2d September that 6 piles of the lower series were forged.

"On the 4th and 5th September, these 6 piles were erected in place, and, by the 21st, the three remaining lower piles had been placed, and three of the braces belonging to that series placed also.

"From the 21st September until the 7th October, no landing could be effected upon the rock. On that day the middle pile of the upper series was placed in its position; on the 10th October, two more were put up; on the 12th, five more, and on the 16th the last pile of the upper series was set in its place. On the 26th October, the cap, or spider, a casting to rest upon the heads of the piles to receive the dwelling-house of the keeper and the lantern, consisting of eight arms and weighing five tons, was hoisted partially towards its place, and on the 30th October this difficult undertaking was successfully completed, and the spider fixed in its proper position and secured there, at an

* Increased to 10 inches diameter at the surface of the rock.

elevation of fifty-five feet above the top of the rock.

The Boston light being a revolving light, and the Minot being the next in order upon the coast, should be a fixed light; accordingly the apparatus ordered is of that character, and is composed of fifteen brass lamps, with reflectors of 21 inches diameter in the clear, with very heavy plating of silver, and of the best description of work.

"The framing of the lantern is of wrought-iron, and is a polygon of sixteen faces, diameter at the angles eleven feet six inches, height six feet six inches, furnished with cast-iron ventilator, the glass, French plate, forty-four inches by twenty-four inches, and three-eighths of an inch thick; the extent of the illumination will be two hundred and ten degrees.

"Thus, it will be seen that the entire height of the structure, from the surface of the rock to the top of the lantern, is about seventy feet, and upwards of fifty feet above the line of highest water.

"The weight of iron work in the shafts, braces, couplings, collars, spider, or cap, and columns for keeper's house is nearly seventy tons; of this, upwards of forty tons is wrought-iron, and the residue of cast-iron; the average weight of each complete shaft is about 8,200 pounds; the cast-iron couplings for connecting the upper shafts with the lower are three feet long, and weigh nearly 800 pounds each; they are made of the best gun-metal. The weight of the lantern and illuminating apparatus will be about four and a half tons. The lantern, lamps, reflectors, and other fixtures for the lighthouse will cost four thousand five hundred dollars, as will appear by the detailed estimates of same, rendered on the 24th ultimo.

"Below the keeper's house, and inclosed within the pile-heads, a species of cellar, or store-room, of the size of the house, is to be built, to contain oil, fuel, provisions, &c.

"It may be considered not unwise to allow the skeleton structure to stand through one winter exposed to the fury of the sea, before the lighthouse is fitted up with its illuminating apparatus, and before it is occupied by a keeper.

"Very respectfully, sir, your obedient servant,
W. H. SWIFT,

"Captain, Topographical Engineers,

"Colonel J. J. ABERT,

"Chief, Topographical Engineers."

In my remarks upon the screw pile lights erected in England in 1839 and 1840, and later, I have omitted to notice the newspapers' account of the destruc-

tion of the pile light which was being built on Bishop's Rock, on the south coast of England.

In the account which was published, it was stated that the entire structure was swept from the rock in a gale of wind. It was also stated that a cast-iron column of 3½ feet diameter had been placed at the centre of the structure to serve as a stairway! If this was the case, all that is to be remarked upon it is, that the essential principle of the screw pile, i. e., allowing the sea an unobstructed passage through the piles, was entirely disregarded, and from the account as published, it is perfectly clear that the destruction of the building was due entirely to the introduction of the cast-iron column. There is nothing, therefore, in the statement as it has come to us through the newspapers, which should impair confidence in the screw pile, when it is constructed in the usual and proper manner.

It may be well to add, that a Commission of Engineers, at the request of the Collector of the port of Boston, visited the structure, the last autumn, to examine and report upon the condition of the building; and their opinion was, that it was entirely *secure*, and in their judgment equal to "standing the strain of any storm without danger." It seems that the storm of the previous winter had not started the paint at the joints, which were as close as when put together.

This severe test must tend to establish the entire sufficiency of this material for the purpose of lighthouse structures, even in the most exposed situations, when put together with proper care.

MISCELLANEOUS.

MR. NASMYTH'S OIL TEST.

In all the contrivances which have been proposed as oil tests, a most important element has been left out, viz., *time*; inasmuch as the evil which is experienced from the use of a bad quality of oil is only developed after the lapse of several days, when, by the action of the oil upon the metal with which it is in contact, to-

gether with the action of the air, such oils become viscid, and begin to clog instead of facilitating the movements of the machinery it was intended to lubricate.

In the more delicate descriptions of machinery, such as chronometers, watches, clocks, &c., such a defect as the thickening of the oil by lapse of time is a most serious evil; and in examining into the comparative fitness of certain oils for such applications, if we do not include *time* as an element in our examination, we shall be led to form most false conclusions, inasmuch as it is the case that for the first day or two some kinds of oil (linseed oil for example) perform the lubricating duty very well; but at the end of the second or third day they become so thick and viscid as to entirely arrest the motion of the machinery.

The most valuable quality in an oil intended for the lubrication of machinery is *permanent fluidity*. That oil which will for the greatest length of time remain fluid in contact with the iron or brass is, without doubt, the most useful for the purpose. Hence, as before said, the necessity of including the element of *time* in any experiment on the comparative value of such oils.

Some idea may be formed of the importance of having the means of arriving at correct conclusions on this subject, when we know that in some spinning establishments there are upwards of 50,000 spindles in motion at the rate of 4000 or 5000 revolutions per minute! The slightest defect in the quality of the oil in such a case, by its becoming viscid, tells in the most serious way upon the quantity of fuel consumed in generating the power required to maintain at this high velocity such a multitude of moving parts. The slight increase of fluidity consequent on

the rise of temperature, caused by the lighting of the gas in the rooms of a cotton-mill, makes a difference of several horses power in the duty of the engine of an extensive establishment.

The oil test we have now to describe, and which is an invention of Mr. Nasmyth's, consists of a plate of iron 4 inches wide by 6 feet long, on the upper surface of which six equal-sized grooves are planed. This plate is placed in an inclining position, say 1 inch in 6 feet. The mode of using it is as follows:— Suppose we have six varieties of oil to test, and we are desirous to know which of them will for the longest time retain its fluidity when in contact with iron and exposed to the action of the air; all we have to do is to pour out *simultaneously* at the upper end of each inclined groove an equal quantity of each of the oils under examination. This is very conveniently and correctly done by means of a row of small brass tubes. The six oils then make a fair start on their race down hill; some get ahead the first day, and some keep ahead the second and third day, but on the fourth or fifth day the truth begins to come out; the bad oils, whatever good process they may have made at the outset, come soon to a standstill by their gradual coagulation, while the good oil holds on its course; and at the end of eight or ten days there is no doubt left as to which is the best; it speaks for itself, having distanced its competitors by a long way. Linseed oil, which makes capital progress *the first day*, is set fast after having travelled 18 inches, while second-class sperm beats first-class sperm by 14 inches in nine days, having traversed in that time 5 feet 8 inches down the hill. The following Table will show the state of the oil race after a nine days' run:—

Results of Oil Test.

Description of Oil.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Best sperm oil	2 8½	4 2	4 5½	4 6	4 6	4 6	4 6½	Stat.	ft. in.
Common sperm oil	1 7	3 9	4 6½	4 11	5 1½	5 4	5 6½	5 7½	5 8
Galiopoli oil	0 10½	1 2½	1 6	1 6½	1 7½	1 8½	1 9	1 9½	1 9½
Lard oil	0 10½	0 10½	0 10½	0 10½	0 11½	Stat.			
Rape oil	1 2½	1 6½	1 7	1 7½	1 7½	1 7½	1 7½	1 7½	Stat.
Linseed oil	1 5½	1 6	1 6½	1 6½	1 6½	1 6½	1 6½	Stat.	

GOVERNMENT INSPECTION OF THE BRITANNIA BRIDGE.

MENAI STRAITS, Oct. 21.—The public opening of the new tubes, for the down line from London to Holyhead, took place this morning; the great structure being now, in all important respects, complete. On Saturday, Capt. Simmons, the Government inspector, went over it early in the morning, and instituted with the engineers a series of experiments. The first and principal experiment consisted in passing two locomotive engines through the tube, and resting them at intervals in the centre of the sections. At nine o'clock a train of twenty-eight wagons, and two locomotives, with 280 tons of coal, was drawn into all four of the tubes. The deflections were ascertained to be exactly three-fourths of an inch under this load, over the immense mass and area of iron. After a repetition of these experimental ordeals, which occupied several hours, the train of 280 tons, with its two locomotives, was taken out about a mile distant from the tubes, and then suddenly shot through it with the greatest attainable rapidity, and the deflection at this velocity was sensibly less than when the load was allowed to remain at rest in the tube. The manner in which these results were registered and arrived at was by means of a new and curious contrivance, which exhibited the whole of the deflections at the abutments. Messrs. E. and L. Clark, the resident engineers, who have watched minutely from day to day, all the developed peculiarities of the novel undertaking, state that the heaviest gales through the Straits do not produce so much motion over the extent of either tube, as the pressure against the sides of the tubes of ten men, and that the pressure of ten men keeping time with the vibrations, produces an oscillation of $1\frac{1}{4}$ inch, the tube itself making 67 double vibrations per minute. The strongest gusts of wind do not cause a vibration of more than a quarter of an inch. The full effect of a storm caused an oscillation of less than an inch, but when the two tubes are braced together by frames, which is now being done, these motions will be almost annihilated. The action of the sun at mid-day, instead of bending them two or three inches, does not move them more than a quarter or three-eighths of an inch. The daily ex-

pansion and contraction of the tubes varies from half an inch to three inches, attaining either the maximum or minimum, at about three o'clock, A. M., and P. M. These and other results are read by means of self-registering thermometers, placed in mahogany cases, protected by plate glass, and under lock and key. If a compass be held over any part of the bottom of the cells the south pole is affected, and if held over the top of the cells the north pole is affected, and this effect is observable in all parts of the tube, although its position is only about 10° of the magnetic meridian. A chronological summary of the structure may be interesting. On June 30, 1845, the bill sanctioning the construction of the Britannia Bridge was passed by Parliament. In July the preliminary experiments to determine the form of structure commenced. April 13, 1846, the first workmen were engaged on the bridge. April 21, the first stone of the Britannia Tower was laid. On the 13th of June, 1847, the first vessel arrived with iron at the Straits. August 10, the first rivet was inserted. Feb. 22, 1849, the Carnarvon and Anglesey towers were completed. April, 1849, the pontoons were brought to bear. May 4, first tube was completed, and platform cut away. June 20, first tube floated. June 22, last stone in Britannia Tower laid. Nov. 9, first tube deposited in permanent bed. Dec. 4, second tube floated. Feb. 7, 1850, second tube deposited in permanent bed. March 3, Carnarvon small tube lowered. March 5, first engine passed through tube, and last rivet inserted. March 18, single line of tube open for public traffic. June, 10, third tube of second line floated. June 11, third tube deposited. July 25, last tube floated. Oct. 21, second line of tube opened for public traffic. The total cost of the Britannia Bridge has been about £60,000 more than that of the high level bridge at Newcastle, recently opened by the Queen. Preparations are making for covering the tubes with a light arched roof, of peculiar construction. The total length of the bridge is 1834 feet 9 inches, the span of main or water opening is 460 feet, and the quantity of masonry in the bridge is 1,500,000 feet.

COMPARATIVE ELASTICITY OF WROUGHT AND CAST-IRON.

The mean ultimate resistance of wrought-iron to a force of compression, as useful in practice, is 12 tons per square inch, while the crushing weight of cast-iron is 49 tons per square inch; but for a considerable range, under equal weights, the cast-iron is twice as elastic, or compresses twice as much as the wrought-iron.

A remarkable illustration of the effect of intense strain on cast-iron was witnessed by the author, at the works of Messrs. Easton and Amos. The subject of the experiment was a cast-iron cylinder $10\frac{5}{8}$ inches thick, and $14\frac{1}{2}$ inches high, the external diameter being 18 inches.

It was requisite for a specific purpose to reduce the internal diameter to $3\frac{1}{2}$ inches, and this was effected by the insertion of a smaller cast-iron cylinder into the centre of the large one; and to insure some initial strain, the large cylinder was expanded by heating it, and the internal cylinder being first turned too large, was thus powerfully compressed.

The inner cylinder was partly filled with pewter, and a steel piston being fitted to the bore, a pressure of 972 tons was put on the steel piston. The steel was "upset" by the pressure, and the internal diameter of the small cylinder was increased by full three-sixteenths of an inch; *i. e.*, the diameter became $3\frac{1}{16}$ ths of an inch! A new piston was accordingly adapted to these dimensions,—and in this state the cylinder continues to be used, and to resist the pressure; the external layer of the inner cylinder was thus permanently extended $8\frac{1}{30}$ ths of its length. In fact, it can only be regarded as loose packing, giving no additional strength to the cylinder.

Under these high pressures, when confined mechanically, cast-iron as well as other metals appears, like liquids, to exert an equal pressure in every direction in which its motion is opposed.—*Clark's Britannia and Conway Tubular Bridges.*

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LIGHTHOUSE.

A lighthouse of a somewhat peculiar construction has just been completed at the extensive works of Messrs. Fox, Henderson & Co., Smethwick, the following description of which may not be un-

interesting:—The structure consists of a cast-iron tower, or hollow column, of a conical form, 70 feet high from high water to the top of the lantern; 12 feet 6 inches diameter at the base, and 10 feet diameter at the top. It is composed of fifteen horizontal tiers of segmental plates, each tier 5 feet high, and so divided that no one plate exceeds 7 feet in breadth. The plates are provided with flanges strengthened with brackets, and having bolt-holes with bosses opposite each other for bolting together. The thickness of the plates varies from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch. Round the bottom tier of plates there is a large flange, through which a number of long holding-down bolts pass to secure it to the foundation. In the second tier of plates there is a strong cast-iron door, accurately fitted, leading to the staircase, which winds round a central column. Equally distributed throughout the tower are six windows, to give light to the staircase. They are of a circular form, and the frames are made of cast-iron, secured to the plates, and glazed with plates of glass $\frac{3}{8}$ ths of an inch thick. The entrance-door at the foot of the tower is 6 feet 8 inches high, and 3 feet 6 inches in width. The hinges are of brass, and fixed to the door and frame with countersunk headed trap-screws. The gallery platform at the summit of the tower, for the support of the lantern, consists of cast-iron radial plates, $\frac{3}{4}$ ths of an inch thick, truly pointed, fitted, and bolted together. The projectional portion of the platform rests upon eight cast-iron brackets, filled and fixed to the upper tier of segmental plates of the tower. The gallery platform is provided outside with a railing of wrought-iron, 3 feet 6 inches in height, consisting of baluster-rods, fitted to a rail at the top and bottom. The top of the spiral staircase is provided with a deal-boarded inclosure and a deal door, forming a bulkhead, to prevent any draught entering the lantern. The lantern is 10 feet in diameter over all, and 11 feet 6 inches high from the floor of the gallery to the underside of the roof. The lower part, or plinth, is 5 feet 6 inches high, and constructed entirely of cast-iron plates lined with wood. One half of the lantern consists of cast-iron plates, lined with wood, and the other half is glazed with flat plate-glass fixed in gun-metal sash-frames, and fasten-

ed with putty and metal pins. The roof is composed of double plates of sheet-copper. A copper ventilator and a dart weathercock is fixed to the top of the lantern, and a lightning-conductor, tipped with gold, has been added. The whole of the cast and wrought-iron is painted in oil color, with the exception of the bolts and nuts, which are thoroughly coated with coal-tar. The lantern is provided with a reciprocal light illuminating 120° of the horizon, consisting of fourteen Argand lamps and fourteen plated reflectors of the most approved construction. The lantern is reached by ninety-eight steps of cast-iron. The lighthouse, on being completed, was, according to agreement, erected on the premises, and all the parts connected, and it is at present standing in its complete state on a rising ground near the canal. On two occasions the lantern has been lighted, and produced a wonderful effect—surpassing expectation—and at night was seen at an immense distance. The drawings, &c., were supplied by Mr. Cowper, the engineer at the London Works. The lighthouse is for the East India Company, and its destination Middleton Point, Saugor Island, India.—*Birmingham Gazette.*

ON THE LUNAR SURFACE, AND ITS RELATION TO THAT OF THE EARTH. BY MR. NASMYTH.

The vast number and magnitude of crater-formed mountains, with which every portion of the Moon's surface appears to be covered, has led Mr. Nasmyth to the conclusion, that these crater-formed mountains are really the craters of extinct lunar volcanoes; pointing out the frequent occurrence of the central cone, the result of the last eruptive efforts of an expiring volcano, a feature so familiar to all those who have observed volcanic craters on the Earth's surface. This central cone Mr. Nasmyth showed to exist in the majority of the lunar craters; and thereby drew the conclusion, that they were the result of the same kind of action which has produced them on the volcanoes of the Earth. The cause of the vast numbers of such volcanic mountains with which the lunar surface is bespattered was next considered, and traced to the rapid consolidation and contraction of the crust of the Moon; whose

mass or bulk being only $\frac{1}{84}$ of that of the Earth, while its surface is the $\frac{1}{16}$, has, in consequence of these proportions, a radiating or heat-dispensing surface four times greater than that of the Earth in relation to its bulk. From this geometrical consideration, Mr. Nasmyth explained how it was that by the rapid cooling and collapse of the crust of the Moon on its molten interior, the fluid matter under the solid crust was, by this "hide-binding" action, forced to find an escape through the superincumbent solid crust, and come forth in those vast volcanic actions which, in some remote period of time, have covered its surface with those myriads of craters and volcanic features that give to its surface its remarkable character. The cause of the vast magnitude of the lunar craters was next alluded to; and assigned, as in the former case, to the rapid and energetic collapse of the Moon's crust on its yet molten interior,—the action as regards the *wide dispersion* of the ejected matter being enhanced by the *lightness* of the erupted matter, seeing that the force of gravity which gives the quality of *weight* to matter on the Moon as on the Earth is so very much less on the surface of the Moon than on the Earth,—so that the collapse action had to operate on material probably not half the weight of cork, bulk for bulk. The causes of those vast ranges of mountains seen on the Moon's surface was next touched on; and Mr. Nasmyth endeavored to explain them by the continued progress of the collapse action of the solid crust of the Moon crushing down or following the contracting molten interior, which, by the gradual dispersion of its heat, would retreat from contact with the interior of the solid crust, and permit the crust to crush down and so force that portion of the original surface *out of the way*, and in consequence of this action assume the form and arrangement of mountain ranges. Mr. Nasmyth, in illustration of this important action, adduced the familiar case of the wrinkling of the surface of an apple, by reason of the contraction of the interior and the inability of the *surface* to accommodate itself to the change otherwise. The mountain ranges in question Mr. Nasmyth considers to be nothing more or less than the material which in the original expanded globes formed the

comparatively level crust of the Moon and Earth. The fall of the unsupported crust on the retreating nucleus, resulting in a tremendous splash on the subjacent molten mass, was described to yield a very probable explanation of the appearance of granitic and igneous centres of certain mountain ranges, as well as the injection of igneous rocks, in the form of trap dykes and basaltic formations, which appear to have come forth in this manner from below the crust of the Earth, and overlay formations of comparatively very recent formation. The origin or cause of those bright lines which radiate from certain volcanic centres of the Moon's surface (Tycho, for instance) is alluded to, and illustrated by a very striking experiment, of causing the surface of a globe of glass filled with water to collapse on the fluid interior by rapidly contracting the surface while the water had no means of escape. The result was the splitting or cracking up of the surface of the globe in a multitude of radiating cracks, which bear the most remarkable similarity to those on the Moon. Mr. Nasmyth further illustrated this subject by reference to the manner in which the surface of a frozen pond may be made to crack by pressure from underneath,—so yielding radiating cracks from the centre of convergence, the chief discharge of water will take place, while simultaneously all along the lines of radiating cracks the water will make its appearance:—thus explaining how it is that the molten material, which had in like manner been under the surface of the Moon during that period of its history, came forth simultaneously up through the course of the cracks, and appeared on the surface as basaltic or igneous overflow, irrespective of surface inequalities.—*Proceedings of British Association.*

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EXPERIMENTS ON THE POWER WHICH
MAINTAINS BODIES IN THE SPHEROIDAL
STATE, BEYOND THEIR SPHERE OF
PHYSICAL AND CHEMICAL ACTIVITY.
BY MONS. BOUTIGNY, OF EVREUX.

Translated from the *Moniteur Industriel*, for the *London Mechanics' Magazine*.

The diversity of opinion existing as to the cause of the tendency of bodies to assume the spheroidal state, induced me to make the following experiments:

I rolled in a spiral form a platinum

wire of 0 m. 001 in diameter, so as to make a sort of sieve with continuous circular meshes; I then poured into this vessel water, alcohol, and ether successively; and, as may be supposed, these three liquids ran through the meshes of the vessel as through a sieve.

This fact ascertained, I made the vessel red hot, and repeated the experiment with the three above-mentioned liquids, when I beheld a repetition of the miracle of the vestal "Tuccia;" that is to say, these three liquids no longer passed through the meshes of the sieve, but could actually be removed from place to place, as if in a close vessel.

As to the alcohol and the ether, I observed that the vapor they generated (its density being considerably higher than that of the air) formed an equilibrium (or a counterpoise) up to a certain point, with the ascending current of hot air produced by the high temperature of the vessel; and this vapor escaping through the vessel, ignited above and below; thus the spheroid of liquid became interposed between the bases of two cones of flame. Thence it is clear, that the vapor escaping freely and uniformly from the whole surface of the spheroid, would not be adequate to produce a reaction sufficient to neutralize the influence of gravity, and to maintain the spheroid beyond the sphere of physical and chemical activity.

In repeating the preceding experiment with iodine, it is still more conclusive. The lower cone of flame is replaced by a beautiful column of violet vapor, which falls through the meshes of the sieve, immediately underneath the spheroid of iodine.

The experiments which I have just summarily described, appear to me to establish fully the existence of this mysterious repellent power which neutralizes the action of gravity. Certainly these experiments do not prove that the action of attraction is destroyed, but they show that we should also take the repulsive power into consideration.

What, then, are the laws of this power? To what distance does its influence extend? What is the action of the earth, or of the incandescent body, as to its nature, its bulk, and its temperature? What is the effect of the density of the body which is rendered spheroidal?—Ma-

ny other questions arise on this subject, which presents, if I mistake not, one of the most extensive fields for analytical investigation.

The truth is, that the spheroidal state is the primordial condition of matter; that all the phenomena which during fifteen years I have had the honor of submitting to the Academy, belong to the physical condition of the primitive eras of the globe; that all the experiments of the laboratory were accomplished on a vast scale, upon the surface of the earth, at the period of its incandescence.

Immense researches might be made on this subject, and innumerable results collected from its investigation.

THE EFFECTS OF ZINC ON IRON.

A letter from Mr. James Nasmyth, of Bridgewater Foundry, Patricroft, near Manchester, to the *Mining Journal*, communicates the results of some experiments recently made at the desire of the Lords of the Admiralty, with a view to determine whether old iron that had been galvanized, or coated with zinc, was rendered unfit for being again worked up. The results of these experiments seem to prove that the quality of the iron is improved instead of being deteriorated by the zinc combined with it. The following is Mr. Nasmyth's report of the experiments:—

"A piece of galvanized iron-wire rope was welded up into a bar, and put to the most severe test. In the first place it was found, that although the iron-wire was quite covered with metallic zinc, which although partially driven off in the process of welding, yet, so far from the presence of the metal, or its oxide, presenting any impediment to the welding of the iron (as in the case of lead), the iron-wire welded with remarkable ease; and the result was, a bar of remarkably tough, silvery-grained iron, which stood punching, splitting, twisting and bending, in a manner such as to show, that the iron was not only excellent, but to all appearance, actually improved in quality in a very important degree.

"Encouraged by such a result, a still further, and even more severe, trial was made—viz: by welding up a pile of clippings of galvanized iron plates, or sheet-iron, covered with zinc, as in the former experiments. The presence of the zinc appeared to offer no impediment to the welding, and the result was, a bloom or bar of iron—the frac-

ture of which presented a most remarkable and beautiful silvery grain—as good, if not superior, in aspect to the finest samples of 'Low Moor' or 'Bowling' iron. Bloom of this iron were rolled out in rods, and tested in the cable-proving machine, and the result indicated from 5 to 10 per cent. higher strength than the best samples of wrought-iron—thus establishing the fact, that, so far from the presence of zinc being destructive to the strength and tenacity of wrought-iron, the contrary is the case.

"I may mention, that bars of iron were heated to a welding heat, prepared by Scarf for sheathing, in the usual manner; and, on drawing them from the fire, for being welded, a handful of zinc filings was thrown on the welding hot surface, and the welding proceeded with. In this severe test no apparent impediment to the process resulted; the iron welded as well as if no zinc had been present."

PRACTICAL RECIPES IN THE ARTS AND MANUFACTURES.

The following valuable recipes, for the preparation of the colors used in painting on porcelain, earthenware, &c., are those which are employed by the principal color makers of the potteries.

Mat Blue.—Alumina, 30 parts; oxide of zinc, 5 parts; and cobalt, 5 parts. Mix, and fire to a biscuit heat, in an open crucible.

Mazarine Blue.—Alumina, 9 parts; oxide of zinc, $1\frac{1}{2}$ parts; and cobalt, $1\frac{1}{2}$ parts. Proceed as above.

Ultramarine.—Alumina, 28 parts; oxide of zinc, 7 parts; and cobalt, 7 parts. Proceed as above.

Sky Blue.—Alumina, 8 parts; oxide of zinc, 1 part; and cobalt, 1 part. If required of deeper color, add more cobalt.

Pink.—Oxide of tin, 21 parts; whitening, 9 parts; and yellow chrome, 1 part. Mix, and fire in biscuit dishes or tiles, one inch deep, not covered. This must have a grate fire.

Purple.—Oxide of tin, 18 parts; whitening, 9 parts; yellow chrome, $1\frac{1}{2}$ parts; and cobalt, $1\frac{1}{2}$ parts. Proceed same as for pink.

Yellow.—Tin ash, 20 parts; antimony, 10 parts; and litharge, 10 parts. Proceed as above.

Orange.—Croceus martis, 8 parts; antimony, 12 parts; and litharge, 8 parts. Proceed as above.

Brown.—Chromate of iron, 30 parts;

and oxide of manganese, 6 parts. If wanted darker, add more manganese. Proceed as above.

Black.—Oxide of manganese, 3 parts; chromate of iron, 30 parts; and cobalt, 6 parts. Proceed as for brown.

Blue Green.—Alumina, 18 parts; yellow chrome, $4\frac{1}{2}$ parts; bichromate of potash, $4\frac{1}{2}$ parts; sugar of lead, $4\frac{1}{2}$ parts; borax, $1\frac{1}{2}$ parts; and cobalt, $1\frac{1}{2}$ parts. Mix, and fire in an open crucible: if covered, the colors separate from the borax, and silex used in this and the following.

Blue Green (No. 2).—Alumina, 15 parts; sugar of lead, 3 parts; yellow chrome, 6 parts; silex, 2 parts; cobalt, 1 part; and borax, 1 part. Proceed as above.

Victoria Green.—Silex, 9 parts; whitening, 6 parts; bichrome potass, 9 parts; sugar of lead, 6 parts; borax, 3 parts; and yellow chrome, 9 parts. Proceed as above.

Albert Green.—Silex, 6 parts; whitening, 6 parts; bichromate of potash, 6 parts; sugar of lead, 4 parts; and borax, 2 parts. Proceed as above.

Marune.—Pink color, 2 parts; and purple color, 1 part. Mix.

Gold Color.—Glass of antimony, 2 parts; red lead, 2 parts; and broken china, 1 part. The above mixed together, and fired to nearly a white heat in covered crucibles.

Grass Green.—Calcined flint, 3 parts; whitening, 2 parts; borax, 1 part; and green chrome, $1\frac{1}{2}$ parts. Mix: fire as blue green. If wanted darker, add green chrome.

Pea Green.—Flint, 3 parts; whitening, 3 parts; yellow chrome, 2 parts; sugar of lead, $2\frac{1}{2}$ parts; bichromate of potash, $2\frac{1}{2}$ parts; borax, 1 part; and cobalt, $\frac{1}{4}$ part. Proceed as above.—*Patent Jour.*

A POOR MAN'S TALE OF A PATENT.

In a recent number of Dickens's "Household Words," we find the following history of the distresses of a poor patentee:—

"After a deal of trouble, I found out a Master in Southampton Buildings, Chancery-lane, where I made the declaration, and paid 18*d*. I was told to take the declaration and petition to the Home Office, in Whitehall, where I left

it to be signed by the Home Secretary (after I had found the office out), and where I paid 2*l*. 2*s*. 6*d*. In six days he signed it, and I was told to take it to the Attorney-General's Chambers, and leave it there for a report. I did so, and paid 4*l*. 4*s*. Note.—Nobody, all through, ever thankful for their money, but all uncivil. My lodging at Thomas Joy's was now hired for another week, whereof five days were gone. The Attorney-General made what they called a report-of-course (my invention being, as Sir William Butcher had delivered before starting, unopposed), and I was sent back with it to the Home Office. They made a copy of it, which was called a warrant. For this warrant I paid 7*l*. 13*s*. 6*d*. It was sent to the Queen, to sign. The Queen sent it back signed. The Home Secretary signed it again. The gentleman threw it at me when I called, and said, 'Now take it to the Patent Office in Lincoln's Inn.' I was then in my third week at Thomas Joy's, living very sparing, on account of fees. I found myself losing heart. At the Patent Office in Lincoln's Inn, they made 'a draught of the Queen's bill' of my invention, and a 'docket of the bill.' I paid 5*l*. 10*s*. 6*d*. for this. They 'engrossed two copies of the bill—one for the Signet Office, and one for the Privy-Seal Office.' I paid 1*l*. 7*s*. 6*d*. for this. Stamp duty over and above, 3*l*. The engrossing-clerk of the same office engrossed the Queen's bill for signature. I paid him 1*l*. 1*s*. Stamp duty again, 1*l*. 10*s*. I was next to take the Queen's bill to the Attorney-General again, and get it signed again. I took it, and paid 5*l*. more. I fetched it away and took it to the Home Secretary again. He sent it to the Queen again. She signed it again. I paid 7*l*. 13*s*. 6*d*. more for this. I had been over a month at Thomas Joy's. I was quite wore out, patience and pocket. Thomas Joy delivered all this, as it went on, to William Butcher. William Butcher delivered it again to three Birmingham parlors, from which it got to all the other parlors, and was took, as I have been told since, right through all the shops in the north of England. Note.—William Butcher delivered at his parlor in a speech, that it was a patent way of making chartists. But I hadn't nigh done yet. The Queen's bill was to be took to the Signet Office in Somerset

House, Strand—where the stamp shop is. The Clerk of the Signet made ‘a Signet-bill for the Lord Keeper of the Privy Seal.’ I paid him 4*l.* 7*s.* The Clerk of the Lord Keeper of the Privy Seal made ‘a Privy Seal bill for the Lord Chancellor.’ I paid him 4*l.* 2*s.* The Privy Seal bill was handed over to the Clerk of the Patents, who engrossed the aforesaid. I paid him 5*l.* 17*s.* 8*d.*; at the same time I paid stamp duty for the patent, in one lump. 30*l.* I next paid him for ‘boxes for the patent,’ 9*s.* 6*d.* Note.—Thomas Joy would have made the same at a profit for 1*s.* 6*d.* I next paid ‘fees to the Deputy, the Lord Chancellor’s Purse-bearer,’ 2*l.* 2*s.* I next paid ‘fees to the Clerk of the Hanaper,’ 7*l.* 13*s.* I next paid ‘fees to the Deputy-clerk of the Hanaper,’ 10*s.* I next paid to the Lord Chancellor again, 1*l.* 11*s.* 6*d.* Last of all, I paid ‘fees to the Deputy Scaler and Deputy Chaff Wax,’ 10*s.* 6*d.* I had lodged at Thomas Joy’s over six weeks, and the unopposed patent for my invention, for England only, had cost me 96*l.* 7*s.* 8*d.* If I had taken it out for the United Kingdom, it would have cost me more than 300*l.*”

GREAT ATMOSPHERIC WAVE.

The spring of 1849 was remarkable for a continuous movement westward of the atmosphere, for the space of seventeen days, namely, from the 1st to the 18th of February. The mean reading of the barometer during that period was fully half an inch above its average value, and when the crest of the wave was over Greenwich, the reading of the barometer at the level of the sea was as high as 30·90 m. The base of the wave must have been in extent just about equal to the distance from England to America; for it appears that on the same day that it completed its passage at Greenwich, it was felt for the first time at Boston. It must have travelled, therefore, at the rate of about 170 miles a minute.

THE TWO VOLTAS.—CURIOUS COINCIDENCE IN NAMES.

“Pliny tells us that it appeared from ancient annals, that by means of certain sacrifices and ceremonies, thunder could be made to descend, or at least that it could be obtained from the heavens. An

ancient tradition relates, that this was practised in Etruria among the Volscians, on account of a monster, called VOLTA, which, after having ravaged the country, had entered their city, and that their king, Porsenna, caused the fire of heaven to fall upon it.”—*European Magazine*, vol. xxii., October, 1792, pp. 263-4.

Animal electricity was discovered by Professor Galvani, of Bologna, in 1791, but the discovery was extended by VOLTA, and is consequently, better known as “Voltaic Electricity,” than as “Galvanism.”

THE REALITY OF SPECTRAL APPEARANCES TRACED TO NATURAL CAUSES.

(From “Reichenbach’s Researches on Magnetism” —Dr. Gregory’s Translation.)

A ease which occurred in the garden of the blind poet Pfeffel, has been widely circulated by the press, and is well known. I shall here mention so much of it as is essential. Pfeffel had engaged a young Protestant clergyman, of the name of Billing, as amanuensis. The blind poet, when he took a walk, held Billing’s arm, and was led by him. One day, as they were walking in the garden, which was at some distance from the town, Pfeffel observed, that as often as they passed over a certain spot, Billing’s arm trembled, and the young man became uneasy. He made inquiry as to the cause of this, and Billing at last unwillingly confessed, that as often as he passed over that spot, he was attacked by certain sensations, over which he had no control, and which he always experienced where human bodies lay buried. He added, when he came to such places at night, he saw *strange* things. Pfeffel, with the view of curing the young man of his folly, as he supposed it to be, went that night with him to the garden. When they approached the place in the dark, Billing perceived a feeble light, and when nearer, he saw the delicate appearance of a fiery ghost-like form hovering in the air over the spot. He described it as a female form, with one arm laid across the body, the other hanging down, hovering in an upright posture, but without movement, the feet only a few hand-breadths above the soil. Pfeffel, as the young man would not follow him, went up alone to the spot, and struck at random all round with his stick. He also ran through the spectre, but it neither moved nor chang-

ed to Billing's eyes. It was as when we strike with a stick through a flame; the form always appeared again in the same shape. Many experiments were tried during several months; company was brought to the place, but no change occurred; and the ghost-seer adhered to his earnest assertions; and, in consequence of them, to the suspicion that some one lay buried there. At last Pfeffel had the place dug up. At a considerable depth, they came to a firm layer of white lime, about as long and as broad as a grave, tolerably thick; and on breaking through this, the bones of a human being were discovered. It was thus ascertained that some one had been buried there, and covered with a thick layer of lime, as is usually done in times of pestilence, earthquakes, and similar calamities. The bones were taken out, the grave filled up with earth and scattered abroad, and the surface levelled. When Billing was now again brought to the place, the appearance was no longer visible, and the nocturnal ghost had vanished for ever. It is hardly necessary to point out to the reader what I think of this story, which caused much discussion in Germany, because it came to us on the authority of the most trustworthy man alive, and relieved from theologians and psychologists a thousand frightful interpretations. To my eyes, it belonged entirely to the domain of chemistry, and admitted of a simple and clear scientific explanation. A human corpse is a rich field for chemical changes,—for fermentation, putrefaction, gasification, and the play of all manner of affinities. A layer of dry quick lime, compressed into a deep pit, adds its own powerful affinities to organic matters, and lays the foundation of a long and slow action of these affinities. Rain-water from above is added; the lime first falls to a mealy powder, and afterwards is converted, by the water which trickles down to it, into a tallow-like external mass, through which the external air penetrates but slowly. Such masses of lime have been found buried in old ruined castles, where they have lain for centuries; and yet the lime has been so fresh, that it has been used for the mortar of new buildings. The carbonic acid of the air, indeed, penetrates to the lime, but so slowly, that in such a place a chemical process occurs which

may last for many years. The occurrence in Pfeffel's garden was therefore quite according to natural laws, and since we know that a continual emanation of the flames of the crystalline force* accompanies such processes, the fiery appearance is thus explained. It must have continued until the affinities of the lime for carbonic acid, and for the remains of organic matter in the bones, were satisfied, and finally brought in equilibrium. Whenever, now, a person approached who was, to a certain degree, sensitive, but who might yet be or appear in perfect health; and when such a person came within the sphere of these physical influences, he must necessarily have felt them by day, like Mlle. Maix, and seen them by night, like Mlle. Reichel. Ignorance, fear, and superstition, would now give to the luminous appearance the form of a human spectre, and supply it with head, arms, and feet; just as we can fancy, when we will, any cloud in the sky to represent a man or a demon. * * *

Thousands of ghost stories will now receive a natural explanation, and will thus cease to be marvellous. We shall even see, that it was not so erroneous or absurd as has been supposed, when our old women asserted, as every one knows they did, that not every one was privileged to see the spirits of the departed wandering over their graves. In fact, it was at all times only the sensitive who could see the imponderable emanations from the chemical change going on in corpses, luminous in the dark. And thus I have, I trust, succeeded in tearing down one of the densest veils of darkened ignorance and human error.

REVIEWS.

The Commercial Hand-Book of Chemical Analysis. By A. NORMANDY. 12mo. pp. 640. London, 1850.

We may fairly suppose that the adulteration of drugs as well as articles of food to be carried on in the "new" as in the "old country;" and very possibly the art is pursued here with the usual Yankee determination of not being outdone by their neighbors.

* Luminous emanations from magnetized bodies lately discovered by the author which are visible in the dark to some persons of fine optical sensibility.

Under these circumstances, a perusal of this book may not be amiss.

We quote a few passages, that our readers may judge for themselves of the character of the work :—

"It is a positive fact that the bloom is most extensively given to green teas at home, in the warehouses of our own merchants, by means of magnesia and Prussian blue. It should be known that the seemingly unbroken appearance of the sheet of metal, in which the tea is tightly packed in the chest, is no criterion of its genuineness. Through the hole which is made in the metallic sheet for the purpose of taking sample, the whole of its contents are emptied on a clean floor, and the tea is then mixed with whatever composition it may be thought fit to add, or worked up with teas of an inferior quality, or which by themselves would be unsaleable. The repacking is done by re-introducing the tea by small portions at a time, and the workman from time to time carefully puts his foot through the opening which was made for taking sample, and through which the tea was emptied; then grasping a rope fixed against the wall in order to steady himself, and keep his balance without danger of enlarging the hole, he heavily treads the tea down by a series of jerks, until at last a quantity of tea equal to the weight at first emptied is thus pressed into the same bulk or space as before, so that the chest has all the appearance of a genuine importation. Even this trouble of repacking the sophisticated tea is grumbled at by the tea-dealer or merchant, and many attempts have been made to imitate the beautiful seam or soldering by which the sheets of metal are united, which, of course, would enable the sophisticator to repack his teas after treatment at once and off hand, but the Chinese mode has hitherto baffled the ingenuity of all the tinsmiths and plumbers who have been applied to. The sheet-lead of the package may be easily enough taken asunder, but the re-soldering is another affair, and could not hitherto be even remotely approached.

"Beside the substances which have been named before, black tea is also mixed sometimes with pulverized extract of logwood; this is immediately detected by moistening a small portion of the tea-leaves of the sample with water, and rubbing it gently about upon a sheet of white paper, which, in that case, will be stained bluish-black; moreover, if a portion of the tea, being thrown in cold water, imparts immediately to the liquid a pinkish or purplish color, which is rendered red by the addition of a few drops of sul-

phuric acid, it is a sign of the presence of logwood; for genuine black tea produces only, after a time, a golden brown liquor which is not reddened by sulphuric acid. This addition of logwood to black tea is for the purpose of simulating strength by the high color of the infusion, something like the addition of chicory to coffee. I have met with this kind of adulteration in teas represented as souchong and pekoe.

"Black tea is sometimes dusted with a little plumbago (black lead) which gives it a shining or lustrous appearance. This impurity remains as a black powder with the silica.

"Tea is sometimes adulterated by an admixture of sloe or elder leaves; the only means of detecting this fraud is by a careful examination of the leaves after they have been untwisted by infusion or moisture; tea-leaves have a different structure—they are more elongated, the edges are more deeply serrated and more delicate than those of the above-named plants.

"Lastly, tea is sometimes adulterated, it is said, by an admixture of tea-leaves which have been already used, and which are dried again and twisted in imitation of the state in which they were originally. This kind of fraud can hardly be detected in any other way than by the want of flavor of the infusion which such tea yields.

"A few months ago, a brownish powder was, and I believe continues to be, offered for sale under the name of *la veno beno*, one quarter of a spoonful of which is described as having the wonderful property of giving to two tea-spoonfuls of tea the strength of four, with an improved flavor, besides producing a saving of 75 per cent.!

"*La veno beno* has been represented as being the leaf of a tree, and that tree a climbing plant, well known in the East under the name of *Pain*; which is clearly a much less pretty, and, consequently, a much less saleable name than *veno beno*.

"But by whatever name called, *la veno beno* is neither plant nor leaf, but simply a mixture of a very small portion of tea-powder (broken tea-leaves), with an excessively large quantity (upwards of 90 per cent.) of pulverized catechu. Catechu, or terra japonica, is an astringent extract, which is extensively used by tanners and dyers as a substitute for gall-nuts. The extraordinary properties of *veno beno* lie therefore altogether in the contrivance by which a price five or six times greater than its real value is extracted from the pockets of a well-advertised public. In my opinion it has another property, though not an extraordinary one, I mean that of spoiling the flavor of good tea, the fine aroma

of which, far from being *improved* by the recommended addition, is, on the contrary, overcome and destroyed by the sweetish-astringent and peculiar flavor of the catechu. To me, therefore, the addition would prove a clear loss, for, having tried it, I could not drink the infusion, which was thus rendered more rough to the tongue, but singularly vapid and flat, yet the quantity used was below that prescribed. *La veno beno* acts, therefore, upon tea somewhat in the same way as chicory does upon coffee; with this important difference, however, that coffee adulterated, or mixed with chicory, still retains a taste of coffee and is drinkable, even though thus adulterated to a considerable extent; but the aroma of tea being much more delicate and fugitive, any substance having a peculiar taste is sure to predominate, if employed to any notable extent.

"We should, however, be grateful, to a certain extent, to the *inventor* for selling his *veno beno* candidly, though under catching terms, as a tea-adulterating substance, which may or may not be purchased; and we must hope that it will not come into either general or partial use in the grocer's shop, ready mixed with the tea that he retails, as is done with chicory and coffee; though, I am sorry to say, a sample of tea sold by a grocer has already come into my hands which was undoubtedly sprinkled with *veno beno* or *catechu*.

"*Plaster and chalk*, and other substances of that kind, it is said, are sometimes added to milk; but that fraud, it would appear, is *much less frequent than is generally supposed*, doubtless on account of the facility with which such substances are detected, since, on leaving the vessel containing the milk at rest for a short time, they settle down as sediment.

"The most frequent, and one might say the unexceptionable adulteration of the milk sold in towns, consists in the addition of *water*."

And to detect the presence of water, which we make no doubt is intermixed with milk to a greater or less degree, in all cases, Dr. Normandy recommends the employment of the "lactometer."^{*}

"The lactometer is simply a large tube divided into two equal parts. The milk to be examined is poured into the tube up to zero, and the whole is left in a clean and cool place for ten or twelve hours in summer, and from fifteen to sixteen in winter. At

the end of that time the whole of the cream will have risen up, and the quantity per cent. of the cream contained in the milk is then to be determined by the number of degrees occupied by the cream. The thickness or stratum of cream in *pure* milk is generally from 8 to 8½. If the milk submitted to experiment has been mixed, for example, with one-third of water, the quantity of cream produced will be reduced to 6½; if mixed with half water, 5; and if adulterated with two-thirds of its volume, the cream is only 3 per cent. of the bulk."

"The substances which are employed for adulterating bread, besides those which are enumerated in the article on *Flour*, are the following:—

Alum.....	Chalk.
Subcarbonate of magnesia.....	Plaster.
Sulphate of copper.....	Lime.
Sulphate of zinc.....	Clay.
Subcarbonate of ammonia.....	Starch.
Carbonate of potash.....	Water.
Bicarbonate of potash....	Pulp of potatoes.

"The introduction of *alum* in bread appears to be a practice of long standing; it enables the baker to give to bread made of flour of an inferior quality the whiteness of the best bread, and to add potato-flour, ground beans and peas, to a certain extent, to wheat-flour, without materially altering the appearance of the bread. The use of alum by bakers is almost universal in this metropolis; at any rate, I have invariably found distinct evidence of the presence of this material in the bread which I obtained from various bakers, some of which are esteemed of the highest *respectability*.

"The quantity of alum in bread varies however according to the quality of the flour employed, and it appears to act somewhat in the same manner as sulphate of copper, that is to say, it enables the baker to make bread with flour of inferior quality with less labor, and to introduce therein a greater quantity of water, by which the yield is increased. In order to obtain these results, however, a much larger proportion of alum than of the salt of copper is required, since, in fact, no appreciable effect is produced, when the proportion of alum is less than $\frac{1}{8000}$, while with the salt of copper $\frac{1}{15000}$ is sufficient. Hence, although alum is of course very far from being so dangerous as the salts of copper, yet the constant ingestion of that matter, day after day, may prove a source of disease, especially with persons of weak constitutions, or of a bilious or costive habit; sometimes it creates a painful sensation in the stomach, and may even induce nausea, vomiting, gripe, &c.

* See "Lactometer," Appletons' Mechanical Dict.

"The process recommended by M. Kuhlman for the detection of alum in bread, consists in incinerating about 3000 grains of bread, porphyρίζing the ashes so obtained, treating them by nitric acid, evaporating the mixture to dryness, and diluting the residuum with about 300 grains of water, with the help of a gentle heat; without filtering, a solution of caustic potash is then added, the whole is boiled a little, filtered, the filtrate is tested with a solution of sal-ammoniac, and boiled for a few minutes. If a precipitate is formed, it is alumina, which may be collected on a filter, washed, perfectly dried, carefully ignited in a platinum crucible, and then weighed. 50 grains of alumina represent 332 of crystals of alum.

"Another process, indicated by Messrs. Robine and Parisot, consists in crumbling down about 2000 grains of the bread under examination, which should be somewhat stale or dried, in order that it may be more easily crumbled. The mass should be macerated in cold water for two or three hours, and then squeezed through a clean piece of white linen. The liquor thus obtained should now be filtered, and the filtrate being placed in a porcelain capsule, should be evaporated to dryness at a steam heat. The residuum being now treated by a small quantity of water and filtered, the operator divides the filtrate into two portions.

"If aqueous ammonia, or a solution of sal-ammoniac, being poured into one of these portions, and solution of chloride of barium in the other portion, produce in each of them a white precipitate, it is a sign of the presence of alum. That produced by ammonia, more especially, is conclusive.

"Sulphate of iron (green copperas) is sometimes added to beer for the purpose, it is said, of *creating a head*; but whether for this or any other purpose, it is a dangerous addition, which has, to my certain knowledge, created vomiting, colic, and other symptoms of gastro-intestinal irritation. In order to detect the presence of this salt, the beer should be decolorized as much as possible by animal charcoal, filtered, and the filtrate being tested by hydrosulphuret of ammonia, will then produce a black precipitate; by ferrieyanide of potassium, a blue precipitate.

"On the other hand, if a solution of chloride of barium be added to another portion of the filtrate, a white precipitate of sulphate of baryta will be produced, which may be filtered, washed, dried, ignited, and weighed. 117 grains of sulphate of baryta represent 139 grains of crystallized protosulphate of iron.

"The presence of opium may be detected

as follows:—The suspected beer is first to be decolorized as much as possible, by animal charcoal; a portion of the filtrate is then poured into a conical glass, and a few drops of acetate of lead are poured in. In the course of about twelve hours, or sooner, a precipitate will be produced, especially by stirring the whole from time to time, which is a meconate of lead. The precipitate which will have collected at the bottom of the test-glass is then separated from the supernatant liquor by careful decantation, and 30 or 40 drops of sulphuric acid, and a like quantity of protosulphate of iron are then poured on the meconate of lead at the bottom of the test-glass. By this treatment the meconate of lead is decomposed and converted into sulphate of lead, whilst the liberated meconic acid, re-acting upon the protosulphate of iron, produces a beautiful red color.

"Chocolate is a preparation of the cocoa-nut, obtained by grinding the nuts, previously roasted and shelled, in an apparatus, which consists either of a flat stone with a steel cylinder, or of conical stone rollers revolving on a circular table of the same material, or of a mill of a peculiar construction. The mill, or the stones, are heated to about 212° Fahr., and the roasted and shelled cocoa-nuts are submitted with sugar to the grinding operation, by which they are reduced into a syrupy mass, which is received into moulds of various shapes, in which it hardens in cooling.

"Besides cocoa-nuts and sugar, the manufacturer generally adds some arrow-root, many persons preferring the chocolate so prepared, because the oil or butter of cocoa is thereby rendered emulsive and more digestible. The preparation known as *cocoa-powder*, or chocolate powder, when genuine, consists only of cocoa-nibs, sugar, and arrow-root, mixed and ground together, and then pulverized, by passing the mass through a grating-mill, and cooling it.

"Chocolate, as well as cocoa-powder or flakes, prepared as above said, is one of the most grateful, nourishing, and easily digestible articles of food; it belongs to the class of perfectly alimentary substances. Unfortunately, however, many of the preparations of the cocoa-nut, sold under the name of chocolate, of cocoa flakes, and of chocolate powder, consist of a most disgusting mixture of bad or musty cocoa-nuts, with their shells, coarse sugar of the very lowest quality, ground with potato-starch, old sea-biscuits, coarse branny flour, animal fat (generally tallow, or even greaves). I have known cocoa powder made of potato-starch, moistened with a decoction of cocoa-nut shells, and sweetened with treacle; chocolate made with the same materials, with

additions of tallow, and of ochre. I have also met with chocolate in which brickdust or red ochre had been introduced to the extent of 12 per cent.; another sample contained 22 per cent. of peroxyde of iron, the rest being starch, cocoa-nuts with their shells, and tallow. Messrs. Jules, Garnier, and Harel assert, that cinnabar and red lead have been found in certain samples of chocolate, and that serious accidents had been caused by that diabolical adulteration.

"Genuine chocolate is of a dark brown color; that which has been adulterated is generally redder, though this brighter hue is sometimes given to excellent chocolate, especially in Spain, by means of a little annatto. This addition is unobjectionable, provided the annatto is pure, which, however, is not always the case.

"Genuine chocolate should dissolve in the mouth without grittiness; it should leave a peculiar sensation of freshness, and after boiling it with water, the emulsion should not form a jelly when cold; if it does, starch or flour is present. The admixture of flour, or of starch, moreover, may be readily detected by the blue color which is imparted to the decoction, after cooling, by solution of iodine.

"*Brickdust* and other *earthy matters* are detected by incinerating a given weight of the chocolate or cocoa under examination; the impurities remain among the ashes, and may be easily recognized. This adulteration is also readily detected by grating 500 grains of the chocolate in as fine a powder as possible, throwing it into about half a pint of cold water, stirring the whole briskly for about ten minutes, leaving it at rest for about two minutes, and decanting the supernatant liquor. The earthy matter will then have subsided, and will be left as sediment.

"The presence of *animal fats* may be detected by the palate, for the chocolate generally has, in that case, a cheesy flavor; or, when common butter, or oil has been added, it has a rancid flavor. This is quite characteristic; for butter of cocoa always remains perfectly sweet.

"The presence of *animal fats*, or of *oils*, may also be recognized by saponifying a portion of the chocolate as follows:—Rasp about 2000 grains of the chocolate under examination, and boil them with water and some caustic potash. When the fat has saponified, dilute the mass with a sufficient quantity of water, and filter three or four times. The milky filtrate, which is, in fact, a solution of soap, should now be supersaturated with nitric acid; this will separate the fat, which will float on the

liquor after cooling. It may then be collected on a filter, and on rubbing a small portion of it between the fingers, the odor will generally indicate its origin; but more effectually still, by heating it in a small capsule. Pure butter of cocoa has no odor.

"Or the chocolate may be exhausted by sulphuric ether, and by evaporating it the fat will be left behind, and may then be identified as we have just said.

"The presence of cocoa-nut shells in chocolate appears to be injurious to health. Dr. Ure relates, in his "Dictionary of Arts, Manufactures, and Mines," that samples of chocolate made at the Victualling-yard, Deptford, for the use of the Royal Navy, and manufactured by the Government chocolate mills, were sent to him for examination, by order of the Lords of the Admiralty, under the following circumstances:—

"For some time the chocolate, it would appear, had been distributed to sailors and convicts for their breakfast, at the rate of one ounce daily, when several of the men complained of its producing sickness, vomiting, purging, and other illness, and a few cases terminated fatally. A careful examination of the chocolate failed in detecting any impurity or deleterious substance, except that some gritty matter, incapable of mixing with water, and which, on closer examination, was found to consist of minute spiculæ of the cocoa-bean husks, which, when swallowed, became lodged in the villous coat of the stomach and bowels, where they created irritation and all the symptoms certified by several naval surgeons. 'It was obvious,' observes Dr. Ure, 'that from the insoluble condition of the chocolate, it could be of little use as an article of food, or as a demulcent substitute for milk, and that, in fact, *three-fourths of it were, on this account, an ineffective article of diet, or were wasted.*'

"In France, the chocolate paste has usually a little vanilla incorporated with it, and a considerable quantity of sugar, which varies from one-third of its weight to equal parts, and one pod of vanilla is said to be sufficient to flavor one pound and a half of chocolate. Pure, genuine chocolate improves in its flavor by keeping, which is the reverse with bad or adulterated chocolate, but the roasted beans soon lose their aroma if left exposed to the air."

We have quoted sufficient to show that Dr. Normandy has produced a book which was much wanted, and which will receive the approval of every friend to sanitary improvement. A foreign journal remarks,

"it is, with all its faults, the very best book on the subject which the English press has yet produced."

Report of Commissioners appointed by command of her Majesty to inquire into the Application of Iron to Railway Structures. (Presented to both Houses of Parliament. 1849.)

Iron applied to Railway Structures. By G. D. DEMPSAY. 1849.

Continued from page 62.

Longitudinal compression and extension of cast and wrought-iron.

The Commissioners made many experiments "for the purpose of supplying data for completing the mechanical theory of elastic beams. If a beam be in any manner bent, its concave side will be compressed, and its convex side extended, and an exact knowledge of the laws which govern its compression and extension must precede any accurate general theory of its deflections, vibrations, and ruptures." The law usually assumed—viz., that the longitudinal compressions and extensions are, within certain limits, proportional to the forces by which they are produced, "although very nearly true in some bodies, is not, perhaps, accurately true for any material. Experiments have therefore been made to determine with precision the direct longitudinal extension and compression of long bars of cast and wrought iron. The extensions were determined by attaching a bar 50 feet in length and 1 inch square, to the roof of a lofty building, and suspending weights to its lower extremity. The compressions were ascertained by inclosing a bar 10 feet long and 1 inch square in a groove, placed in a cast-iron frame, which allowed the bar to slide freely without friction, and yet permitted no lateral flexure. The bar was then compressed by means of a lever loaded with various weights. Every possible precaution was taken to insure accuracy. The following formulæ were then deduced for expressing the relation between the extension and compression of a bar of cast-iron, 10 feet long and 1 inch square, and the weights producing them respectively:—

Extension, $w = 116,117 e - 201,905 e^2$

Compression, $w = 107,763 d - 36,318 d^2$

where w is the weight in pounds acting upon the bar, e the extension, and d the compression in inches. And the formulæ deduced from these, for a bar one inch square, and of any length, are—

For extension,

$$w = 12,903,040 \frac{e}{l} - 2,907,432,000 \frac{e^2}{l^2}$$

For compression,

$$w = 12,931,560 \frac{d}{l} - 522,979,200 \frac{d^2}{l^2}$$

where l is the length of the bar in inches. These formulæ were obtained from the mean results of four kinds of cast-iron. The mere tensile strength of cast-iron, derived from these experiments, is 15,711 pounds per square inch, and the ultimate extension $\frac{1}{800}$ of its length, and this weight would compress a bar of iron of the same section $\frac{1}{773}$ of its length. It must be observed that the usual law is very nearly true for wrought-iron."

"Experiments have also been made upon the transverse strength and resistance of bars of wrought and cast-iron, acted upon by horizontal as well as vertical forces. These experiments will be found to exhibit very fully the deflections and sets of cast-iron, and the defect of its elasticity. The bars which were experimented upon by transverse pressure were of sections varying from one inch square to three inches square, and of various other sections, and the actual breaking-weights show that the strength of a bar one inch square should not be taken as the unit for calculating the strength of a larger casting of similar metal, although the practice of doing so has been a prevalent one; for it appears that the crystals in the portion of the bar which cools first are small and close, whilst the central portion of bars two inches square, and three inches square, is composed of comparatively large crystals, and bars of three inches square in section, planed down on all sides alike to three-quarters of an inch square, are found to be very weak to resist both transverse and crushing pressure. Hence it appears desirable, in seeking for a unit for the strength of iron of which a large casting is to be made, that the bar used should equal in thickness the thickest part of the proposed casting."

In the remaining portion of the Report, the Commissioners refer to the information they have collected respecting the qualities of various kinds of cast-iron, and the respective properties of the hot-blast and cold-blast iron. They mention, with approval, a recommendation,

"That engineers, in contracting for a number of girders, should stipulate that they should not break with less than a certain weight (leaving the mixture to the founder),

and cause one more than the required number to be cast. The engineer may then select one to be broken, and if it break with less weight than that agreed upon, the whole may be rejected."

A general description of the several kinds of iron bridges for railways follows, and the Commissioners report, in conclusion, that,

"Considering the attention of engineers has been sufficiently awakened to the necessity of providing a superabundant strength in railway structures, and also considering the great importance of leaving the genius of scientific men unfettered for the development of a subject as yet so novel and so rapidly progressive as the construction of railways, we are of opinion that any legislative enactments with respect to the forms and proportions of the iron structures employed therein would be highly inexpedient.

"We would, however, direct attention to the general conclusions we have arrived at from our own experiments, and from the information supplied to us, namely:

"That it appears advisable for engineers, in contracting for castings, to stipulate for iron to bear a certain weight, instead of endeavoring to procure a specified mixture.

"That to calculate the strength of a particular iron for large castings, the bars used as a unit should be equal in thickness to the thickest part of the proposed casting.

"That, as it has been shown that to resist the effects of reiterated flexure iron should scarcely be allowed to suffer a deflection equal to one-third of its ultimate deflection, and since the deflection produced by a given load is increased by the effects of percussion, it is advisable that the greatest load in railway bridges should in no case exceed one-sixth of the weight which would break the beam when laid on at rest *in the centre*.

"That, as it has appeared that the effect of velocity communicated to a load is to increase the deflection that it would produce if set at rest upon the bridge; also that the dynamical increase in bridges of less than 40 feet in length is of sufficient importance to demand attention, and may, even for lengths of 20 feet, become more than one-half of the statical deflection at high velocities, but can be diminished by increasing the stiffness of the bridge; it is advisable that, for short bridges especially, the increased deflection should be calculated from the greatest load and highest velocity to which the bridge may be liable; and that a weight which would statically produce the same deflection should, in estimating the strength of the structure, be considered as the greatest load to which the bridge is subject. For

the method of calculating this increased deflection, we beg to refer to Appendix B.

"Lastly: the power of a beam to resist impact varies with the mass of the beam, the striking body being the same; and by increasing the inertia of the beam without adding to its strength, the power to resist impact is, within certain limits, also increased. Hence it follows that weight is an important consideration in structures exposed to concussions.

"Whilst, however, we lament that the limited means which have been placed at our disposal, and the great time required for such investigations, have compelled us to leave in an imperfect state, or even to neglect altogether, many interesting and important branches of experimental inquiry, we trust that the facts and opinions which we have been enabled to collect will serve to illustrate the action which takes place under varying circumstances in iron railway bridges, and enable the engineer and mechanic to apply the metal with more confidence than heretofore."

Tensile strength of cast-iron, from various parts of the United Kingdom.

Seventeen kinds of iron used. Specific gravity ranging from 6.906 to 7.181. Form of transverse section of specimens, cruciform. Breaking-weight per square inch of section, from 5.602 tons to 7.949 tons, except the Clyde iron No. 3, of which the breaking-weight per square inch of section reached 10.477 tons. Mr. Morris's Sterling's iron,* hot-blast, mixed and melted with about 20 per cent of malleable iron scrap, had a breaking-weight of 11.502 tons per square inch of section. Another quality, composed of hot-blast, Staffordshire iron, mixed and melted with about 15 per cent. of common malleable iron scrap, had a breaking-weight of 10.474 tons.

Tensile strength of cast-iron of different forms of section.

Forms of section used—*cruciform*, extreme breadth four inches and depth three inches; uniform thickness of arms 64 inches; *rectangular*, 2.3 inches $\times$ 1.75 inches; and *circular*, 2.26 inches diameter; the intended area in all the forms being equal to four

* This and other alloys as they may be called of Stirling's, are very remarkable in their qualities, and will be noticed in a future number.—Ed. M. M.

square inches. Mean breaking-weight per square inch of the *cruciform* section varied from 6·253 tons to 6·784 tons; of the *rectangular*, from 6·115 tons to 6·267 tons; and of the *circular* from 6·614 tons to 6·993 tons. From these results it may be inferred that *little or no difference in the tensile strength of cast-iron arises essentially from the form of its section.*

Strength of cast-iron in various sectional forms to resist crushing.

The first set of experiments were upon *cylinders*, the specimens being in two proportions,—viz., having diameter of section equal to height, and having a height equal to double the diameter of section. In the first cases, the mean crushing-weight per square inch of section varied from 27·512 tons to 28·810 tons. In the second cases, it varied from 24·988 tons to 29·769 tons. The second set of experiments were upon *triangular prisms*, of which the bases were intended to be equilateral triangles, with sides one inch in length: with a height of specimen of one inch, the mean crushing-weight per square inch of section was 29·905 tons, and with a height equal to two inches it was 31·045 tons. The third set of experiments were upon *rectangular prisms*. The base of each prism was intended to be one square inch, with a height of one inch, the mean crushing-weight per square inch of section was 28·112 tons, and with a height of two inches, 26·437 tons.

Comparative power to resist crushing of cast-iron from different parts of the kingdom.

The specimens were cylinders three-quarters of an inch in diameter, and three-quarters of an inch and one inch and a half in height. The general mean crushing-weight per square inch of section varied from 27·004 tons to 49·109 tons. Mr. Stirling's irons required crushing-weights of 54·640 tons and 64·403 tons respectively, the third quality showing the greater resistance.

Ratio of tensile to crushing resistance in cast-iron.

The torn specimens being of a cruciform section, and those crushed of a circular section and cylindrical form. The resistances being reduced to those due to a square inch of section, the ratio is seen to vary from 1: 4·518 to 1: 6·735. The average ratio of the whole (omitting Mr. Stirling's as being a compound iron) is 1: 5·6603.

(To be continued.)

Formule for constructing Railroads: adapted to the practical operations of locating and laying out Railroad Curves. SIMEON BORDEN, Boston.

Mathematics is but one of several accomplishments which the engineer is expected to possess; an important one truly, but by no means one to be cultivated to the exclusion of all others. Its application is universal; but in order to a fair exhibition of its powers, it should be flavored with a little common sense.

We were reminded, on opening this book (which, by the way, presents a fine appearance on the score of mechanical execution), of the notion of a friend of ours, who likens such labor as is here shown to the operation of "breaking an egg with a sledge-hammer;" and did we not know to the contrary, we should say that the author never could have had any thing to do with construction, unless "splitting hairs" comes under that head. A really simple matter, which may be mastered by any young man of ordinary capacity in three weeks, and even in less time, that is to say, so far as understanding the principle of the thing,—is here made to present a most formidable appearance.

Given the two tangents and their intersection (the simplest case), he determines the angle of deflection from the tangent, and taking what he calls a *practical* example, determines this angle to be $0^{\circ} 10' 2'' \cdot 64$; and very properly considering it an awkward angle to lay off, with most instruments, proceeds to make a new calculation, based upon the assumption that the angle be called $0^{\circ} 10'$. All

this is unnecessarily complicated for practice, for which the book is professedly designed.

Again, some eighteen pages are devoted to the subject of *vertical curves*; that is to say, the curves applied to joining the grade lines in a vertical plane. What would be thought in practice, of calculating the elements, and running a vertical curve of some *eight miles radius*, in order to relieve the train of the shock in passing from one grade to another?

And in locating a curve over a river 250 feet wide, the preliminary calculations occupy some twenty-six pages, and require the measurement of between forty and fifty angles, altogether consuming more *days* than the problem requires hours, and presented under the most complicated aspect. There needed but the equation, showing the proper angle for a hod, to render the work complete as a practical one for beginners.

We allude to this work with no intention to disparage the acquirements of its author—he is well known for his profound scientific skill—but simply to point out what we consider one of the impediments to the extension of mathematical knowledge among practical men. When problems of so simple a character come from the hands of a mathematician dressed in such a garb, can we wonder that the mechanic and practical man is slow to believe in the value to him of mathematical knowledge?

PATENTS.

List of American Patents issued at the U. S. Patent Office from Jan. 1 to Jan. 14, 1851.

(Prepared for Appletons' Magazine.)

No. 7865. Improvement in Daguerreotype Pictures. Charles J. Anthony, Pittsburgh, Pa. Jan. 1.
No. 7866. Improvements in Car-Couplings. Silas M. Cochran, Baltimore, Md. Jan. 1.

No. 7867. Improved Nozzle for Lead Pipe Machines. John B. Collan, Reading, Pa. Jan. 1.

No. 7868. Improvement in Planing-Machines for dressing the edges of boards. William E. Cornell, Boston, Mass. Jan. 1. "I claim the method of communicating motion from the bottom to the top roller by two pinions combined with one wheel, having the inner and outer rim of cogs, by means of joint links, as described, and for the purpose specified: also, operating the machinery for carrying the cutter-wheel towards or from the line of motion of the plank, by the passage of the plank over and in contact with a spur-wheel or wheels, whereby the mo-

tion of the cutter-wheel for edging tapering planks will be made to correspond with the motion of the plank itself; also, interposing between the wheel or wheels actuated by the plank, and the carriage of the cutter-wheel, a reversing motion, by means of which the machine can be made to act on the plank from the narrow towards the wide end, or *vice versa*, or by suspending its operation edge the planks with parallel sides."

No. 7869. Improvement in Water-Metres. John Ericsson, New-York city. Jan. 1. "To these ends the principle or character which distinguishes my invention from all other things before known, in an instrument having two cylinders provided with pistons connected with cranks at right angles, or such other angles as will enable the pistons alternately to act on the crank shaft to rotate it, consists in connecting the two pistons with their cranks, so that while the shaft is impelled by one piston the other shall remain at rest at the end of each stroke, until the shifting of the valves is completed, for the purpose of insuring the accurate measurement of the fluid passing through and acting as the motive force. My invention in the above apparatus also consists in determining the range of motion of the pistons, by means of stops at each end connected with the cylinders and pistons, instead of doing this by the cranks; by reason of which I am enabled to measure the fluid passing through with the utmost accuracy,—a result which could not be obtained if the motions of the pistons were determined by the crank, for the least wear of either the crank-pin or the journals of the shaft, or the boxes in which these work, or the slightest change in the position of the cylinders relatively to the parts with which the pistons are connected, occasioned by strain or wear, would of necessity vary the amount of water discharged at each stroke. My invention in the before-mentioned apparatus also consists in attaching to the instrument an outer casing, through which the fluid to be measured passes, and from which it enters the cylinders, which casing incloses the valve and valve gear, as also the other moving parts, and the upper ends of the cylinders, that the various moving parts may work in the fluid, to be lubricated thereby, whilst at the same time the various joints are protected by being pressed with a nearly equal pressure on all sides by the fluid; and also avoiding the use of packing-boxes for the sliding parts of the mechanism. What I claim as my invention, is, connecting the two pistons with the two cranks of a crank-shaft, in manner substantially as described, so that at the end of each stroke of either of the pistons it shall remain at rest, while the crank-shaft is being impelled by the other piston, so that the valves shall be shifted whilst the piston is at rest. I also claim, in an instrument for the purpose herein specified, determining the range of motion of the pistons by means of stops connected with the cylinders and the pistons, in combination with the connection of the pistons with the crank, or cranks, by means of a joint having sufficient play to permit the pistons alternately to remain at rest while the crank-shaft continues to rotate. I also claim inclosing all the moving parts of an instrument in the surrounding casing through which the water, or other fluid, passes to be measured, constructed, and operating in the manner and for the purpose substantially as described."

No. 7870. Improvement in Churns. Daniel Fisher, College Corner, Ohio. Jan. 1.

No. 7871. Method of connecting the Slide-Valve with the Rock-Shaft. Samuel H. Gilman, Cincinnati, Ohio. Jan. 1. "The rod by which the valve is drawn to and fro terminates at its lower extremity in a ball joint, allowing of the aberration of the rod in conformance with the sweep of the arm which operates it. A tubular rod, screwing within the socket of the valve, forms a clamp or cap for the joint at its lower end and a guide rod for the valve. The upper portion of the valve acts in concert with the rod to form the socket for the joint. Pivoted to a lug upon the cylinder head is a rock-shaft, one arm of which is pivoted to the valve rod; the other arm projecting downwards, is linked to the counter arm

of the starting-bar or hand-lever by a rod or link. This handle being fixed at the middle of its sweep by a pin to the quadrant, the joint of the arm becomes a fixed fulcrum, upon which the valve gearing vibrates by the motion of the cylinder."

No. 7872. Improvement in Machines for Assorting Broom-Corn. Lorenzo D. Grosvenor, Harvard, Mass. Jan. 1.

No. 7873. Improvement in Quilting Frames and Apparatus. Abraham Kaufman, Orristown, Pa. Jan. 1.

No. 7874. Improvement in Spring-Carriage Wheels. John Lamb and Charles H. Root. McDonough, N. Y. "The nature of our invention consists in the use of curved flat steel spokes secured to the rim of the wheel at two points, each spoke, and resting on the hub, or nave, through slots in the edge of the hub, with grooves or notches at their extremities overlapping an annular projection in the hub, and further secured by the axle-box, which has grooves into which the ends of the spokes fit, and butt up against the axle-box, being secured to the hub by bolts and projections on the edge of the plate covering the hub, which fits into the slots formed for the spokes, and serving to keep the spokes in their places."

No. 7875. Improvement in Candlesticks. James Manning, Middletown, Conn. Jan. 1.

No. 7876. Improvement in Looms for Weaving Seamless Bags. Sheldon Northrop, New Milford, Conn. Jan. 1. "What I claim as my invention is the arrangement in one loom of two series of cams, as described; one series for weaving the cloth double, and the other single, in combination with the shifting the treddles from one series of cams to the other, or the like equivalent thereof."

No. 7877. Improvement in Seed-Planters. James P. Ross, Lewisburgh, Pa. Jan. 1.

No. 7878. Improvement in Printing Presses. Stephen P. Ruggles, Boston, Mass. Jan. 1. "What I claim as my invention is the gauge-bar for cards, in combination with the vibrating platten and stop-finger, and crank which operates the same. I also claim the use of a segment of a cylinder, in combination with the stationary form-bed, so that the rotary inking-apparatus may move over the form, and then, after taking ink from the fountain, distribute it on said cylinder. I also claim the movable bearers on the side of the form-bed, so as to be moved outwards when the inking-rollers are passing over the form, and drawn inwards when the sheet or tympan is moved up to said form. I also claim regulating the delivery of the ink, by combining with the delivering-roller a grooved ratchet-wheel and weighted pawl-band, operating with the lever stud, cam-roller, and stop-lever. I also claim supporting the journals of one of the inking-rollers on sliding bearers, so that it may be moved up against the delivering-roll by means of studs on said bearers and cams."

No. 7879. Improvement in Machines for turning Irregular Forms. Jonathan Russell, Philadelphia, Pa. Jan. 1. "The nature of my improvement consists in cutting spokes, &c., &c., or any other irregular forms to pattern, while the pattern and rough material are held fast, and do not revolve."

No. 7880. Improvement in manufacture of India Rubber. Jonathan T. Trotter, New-York city. January 1. "In a solution of caustic lime, potash, or any other caustic alkali, I boil flowers of sulphur, till the liquor is completely saturated. In making this ley, I have the alkali always in excess. After the boiling of the liquor it is removed from the fire, and allowed to stand and cool, when any excess of sulphur in the liquor settles to the bottom, leaving a clean sulphuretted potash solution. This clear liquor is then decanted into another vessel, in which is a concentrated solution of the sulphate of zinc. On the mixture of these two solutions a decomposition takes place, and the zinc is precipitated in the form of a white powder, which may be called a bisulphuret of zinc, or artificial preparation of zinc of similar characteristics, chemically combined. When the zinc has all been precipitated, it is collected and washed and filtered, and then exposed to dry, after which it is ground in an ordinary grinding-mill till it

becomes an impalpable powder. It is in this state mixed and ground with the India-rubber (in the ordinary mills used for that purpose) in the proportion of about 4 lbs. of the preparation of zinc to about 10 lbs. of the rubber; and the composition after being subjected to a heat of or about three to five hours to a temperature of 260° to 280° Fah., according to the thickness of the material, and the purposes to which it is to be applied, is found to be completely cured, or vulcanized, and without the use of free raw sulphur in any way in combination with the rubber."

No. 7881. Improvement in Corn Shellers. Joshua M. C. Armsby, Worcester, Mass. January 7.

No. 7882. Improvement in Spring-Matresses for invalids. David Baird, New-York city. Jan. 7.

No. 7883. Improvement in Rotary Pumps. Phineas Bennet, New-York city. Jan. 7. "In my improved pump the water is acted upon by a rotating wheel composed of vanes or fans on a disc attached to the lower end of a vertical shaft. The water enters the casing at or near the centre of said wheel, and is forced outward by centrifugal force, and thence rises in an annular space between the outer casing and an inner concentric cylinder; the said annular space being provided with curved or spiral partitions, to form water-ways, through which the water shall pass upwards, but with a whirling motion, due to the motion of the wheel and the form of the annular space. In the annular space below the lower edge of the spiral partitions, and above the rotating wheel, there are placed a series of spring or hinged valves, which are opened by the force of the current of water, and which will therefore be opened to an extent due to the force with which the water is acted upon by the wheel. The nature of my invention consists in combining with the rotating fan or paddle-wheel the annular space, provided with curved water-ways, which answer the purpose of guides for the upward flow of the water."

No. 7884. Improvement in Looms for Weaving Tapestry Carpets with parti-colored warp. Erastus B. Bigelow, Clintonville, Mass. Jan. 7. "What I claim as my invention is regulating the delivery of giving out of one or more warps or chains by the separate tension of each substantially as specified, in combination with a ground or controlling warp, which determines the length of cloth made at each beat of the lathe, by having the delivery of the said ground or controlling warp regulated by its tension and controlled by a break or the equivalent thereof, when the lathe beats up. I also claim the employment of an index-wheel or measuring-apparatus, or the equivalent thereof, to indicate the length of figuring warps given out or taken up in the process of weaving, substantially as and for the purpose specified, when this is combined with an index or measuring apparatus to indicate the amount of cloth woven. And lastly, I claim the employment of fingers, moving or vibrating independently of the lathe."

No. 7885. Improvement in Fountain Inkstands. Francis Draper, East Cambridge, Mass. Jan. 7.

No. 7886. Improvement in Machines for Joining Staves. William Maguire, Cincinnati, Ohio. Jan. 7. Claim: "The arrangement, substantially as herein described, of a circular rest, having a sliding motion to and fro, in the plane of its axis, and having around its perimeter, catches, for the retention of the stave during the process of jointing, and rotating the distance from stave to stave at every forward stroke, and held fast for the action of the rotating jointers upon the stave at every return stroke, the jointers and circular rest being so arranged as to impart at the same time to the stave edges any given bevel and taper, according to the size and bilge of the stick."

No. 7887. Improved Fly-Tumbler Lock for Firearms. Stanhope W. Marston, New-York city. Jan. 7. "What I claim as my invention is the fly-tumbler, arranged and combined with respect to the scar and the cock, in the manner and for the purposes set forth in my specification."

No. 7888. Improvement in Grass Harvesters. Edward Neely, Savannah, Mo. Jan. 7. "I claim the manner of suspending the cutter ring from the wheel

by means of straps or other yielding material; also, the combination of the cutters, the bevelled cutter ring, and straps, &c., for the purpose of raising the cutter ring over any obstruction coming against the edge of the knife. I also claim the manner of arranging the guide-board, standard, arm, and strap, secured as described, for the purpose of guiding the machine, and allowing the parts to yield to a sudden stopping of the machine, or to irregularities in the ground.

No. 7889. Improvement in Electro Magnetic Engines. Jacob Neff, Philadelphia, Pa. Jan. 7.

No. 7890. Improved Arrangement of Arches in Bridge Trusses. Cunningham M. Pennington, Rome, Ga. Jan. 7. Antedated Dec. 9.

No. 7891. Improvement in Coal Stoves. James Shields, New-York city, and Samuel Pierce, of Troy, N. Y. Jan. 7.

No. 7892. Improved Parallel Vise. Samuel R. Simpson, Springfield, Ohio. Jan. 7. "What I claim as my invention, and desire to secure by letters patent, is the attaching the lower end of the moving jaw of the vise to a block that is attached to and moves with the end of the screw, in the manner and for the purposes herein described.

No. 7893. Improvement in Ox-Yokes. Andrew L. Simpson, Durham, N. H. Jan. 7.

No. 7894. Improved Means for Revolving the Breeches of Repeating Firearms. James Warner, Mass. Jan. 7.

No. 7895. Improvement in the Manufacture of Caviar. Robert G. Westcott, Worcester, Mass. Jan. 7.

No. 7896. Improvement in Tires for Railroad Car-Wheels. Theodore T. Abbot, Manchester, N. H. Jan. 14. *Claim:* "Making the tire of car-wheels by the combination of several distinct pieces, so arranged and disposed as mutually to support and confine each other."

No. 7897. Improvement in Raising Carriage-Tops. John L. Allen, New Haven, Conn. Jan. 14. "What I claim as my invention, and wish to secure by letters patent, is the application of a spiral-spring to operate upon the braces of a carriage-top, so as to assist in supporting and elevating the top."

No. 7898. Improvements in Looms for Weaving Piled Fabrics. E. B. Bigelow, Clinton, Mass. Jan. 14. "The kind of fabric to be produced in my improved loom, are wrought double; that is, two cloths one above the other, and the pile or figured warps are alternately wrought or woven, first in one and then in the other cloth, the two cloths being kept at the required distance apart by intersecting bars or plates which determine the length of pile for the two fabrics, which is afterwards cut to separate them. In the power-loom as heretofore essayed for the weaving of this kind of fabric, the interposed bars or plates which separate the two fabrics and which pass between the dents of the reed were made stationary or immovable, the pile being cut by means of a knife which vibrates in slots near the front ends of the said bars or plates. This fixed position of the bars or plates is a serious objection, as it prevents the proper vibratory motion of the cloth at the time of the beat and the shedding of the warps. The object of my invention is to avoid this difficulty; and to this end, the nature of my invention consists in so connecting these intersecting bars or plates with the loom, that they shall be free to vibrate to the beat of the lathe and to the shedding of the warps. And my invention also consists in the employment of a stop or stops to arrest the motion of the said bars or plates at a given point, so that the reed in beating up the cloth shall cause the woven cloth to advance on them. What I claim as my invention is connecting the intersecting bars or plates with the loom, so that they shall be free to vibrate and yield to the beat of the lathe and shedding of the warps. And I also claim combining with the said vibrating bars or plates, a stop or stops to arrest them at the required point, that the continued beat of the lathe may cause the fabric to move forward over them."

No. 7899. Improvement in Connecting and Disconnecting Hubs and Axles. A. M. Billings, Claremont, N. H. Jan. 14.

No. 7900. Improvement in Tuyers. Joseph Dewart, Morgantown, Pa. Jan. 14. "My improved tuyer consists of an upright vessel having a chamber within it, which is closed at the top by a movable grate, and at the bottom by a sliding shutter. The vessel is furnished with a wind-pipe, by means of which the blast from the bellows enters the chamber; the wind-pipe at its junction with the chamber curves upwards to cause the air to impinge more directly upon the grate-bars, and a curved partition is introduced within the chamber in such manner that while it assists in turning the blast upwards, it allows any particles which may fall through the grate-bars to pass it and lodge at the bottom of the chamber, where they cannot obstruct the blast, and whence they are removed by withdrawing the sliding shutter. The lower extremity of this partition extends below the orifice of the wind-pipe, and its form is such that an eddy is formed at this point which facilitates the descent of cinders, and thus prevents them from obstructing the wind-pipe." What I claim in the foregoing as my invention is the curved partition in the air chamber placed opposite the orifice of the wind-pipe, with its lower edge extending beneath this orifice, the arrangement and construction of the partition being such that it serves the double purpose of directing the blast upwards, and facilitating the descent of the cinders.

No. 7901. Improvement in Rotary Pumps. J. Stuart Gwynne, New-York city. January 14. "The general features of the machine are a hollow revolving piston within which the water is received at the centre, and from the periphery of which it is thrown by centrifugal power into an outer and stationary case, whence it passes into the outlet pipe, through which it is discharged." [He does not claim to be the inventor of the centrifugal pump, &c. !]

No. 7902. Improvement in Changing a Reciprocating into a Rotary Motion. Joseph Harris, Jun., Boston, Mass. Jan. 14. "The construction and operation of this engine is as follows: The engine is constructed in any of the usual forms, excepting the mode of communication between the crank-shaft and the cross-head (or lever-beam); in this the novelty of my invention consists. In the ordinary mode of producing a continuous revolving motion by a reciprocating one, a single crank and connecting rod are used, the effect of which is an unequal leverage at corresponding divisions of the outward and return strokes. To counteract the effect of this, a heavy fly is added, which diminishes the effective power of the engine. These evils I, in a great measure, remedy, and at the same time produce a gradual check to the momentum of the piston by the use of two cranks, placed at right angles to each other, the said cranks being connected by means of rods to the ends of an oscillating lever, whose fulcrum is a pin attached to and travelling with the cross-head. At the commencement of the stroke the crank-pins stand at equal distances above and below the central line, drawn between the cylinder and crank-shaft, consequently no motion can ensue, and the cranks are on the "dead point;" now, if the shaft be turned in either direction, on the admission of steam to the cylinder, the majority of the power will be communicated to the crank which has the greatest leverage, and the shaft will revolve in that direction. When the cranks have made a "quarter" revolution the leverage is nearly equal on both cranks, and the piston has travelled over one-half of its stroke; on continuing the revolution, the crank which, at the commencement, had the greatest leverage, now has the least; the majority of the power being transferred to the other crank, which continues to the end of the stroke, and the cranks assume their other 'dead point.' The office of the oscillating lever is to equalize or average the combined effects of the cranks on the piston. *Claim:* The application to steam or other engines or machines of a mechanical arrangement, whereby the effect of the applied power is rendered equal (or nearly so) both on the outward and return strokes of any reciprocating or vibrating movement, using for that purpose a combination of cranks, connecting-rods, and an oscillating lever, or their equivalents.

No. 7903. Improvement in Cast-Iron Car Wheels. George R. McFarlane, Hollidaysburg, Pa. Jan. 14. *Claim:* The mode of constructing a cast-iron car wheel by the use of spokes, or arms, composed in part of portions of a hollow cone, connected by brackets, and in part by straight spokes or arms, forming a continuation of plates and spokes; possessing the advantages and obviating the objection of both.

No. 7904. Improvement in Reflectors for Street Lamps. Hugh Sangster and James Sangster, Buffalo, N. Y. Jan. 14.

No. 7905. Improved Steering Apparatus. Joseph E. Andrews, Boston, Mass. Jan. 14.

No. 7906. Improvement in Carriages. John Jones, Clyde, N. Y. Jan. 14.

List of English Patents issued during the Month, from Nov. 2 to Nov. 30, 1850.

Matthew Hodgkinson, of Red-street, near Newcastle-under-Lyne, Stafford, mine agent, for improvements in furnaces or apparatus for smelting ores and minerals, and for the making of pig iron. November 2; six months.

Victor Emile Warinot, of Neuilly, Seine, France, for improvements in dyeing wool and other fibrous materials and fabrics. November 2; six months.

Joseph Christian Davison, of Yalding, Kent, brick-maker, for improvements in lime and other kilns and furnaces. November 2; six months.

John Mathews, of Kidderminster, foreman, for improvements in sizing paper. November 2; six months.

Jonas Bateman, of Upper-street, Islington, cooper, for improvements in life-boats. November 2; six months.

Archibald Slate, of Woodside Iron Works, Dudley, for improvements in canal navigation. November 2; six months.

Pierre Antoine Auguste de la Barre de Nanteuil, of Leicester-street, Middlesex, for improvements in propelling carriages. (Being a communication.) November 2; six months.

William and Colin Mather, of Salford, engineers, and Ferdinand Haselowsky, of Berlin, Prussia, engineer, for improvements in machinery for washing, steaming, drying, and finishing cotton, linen, and woollen fabrics. November 2; six months.

John Borland, of Norfolk-street, Strand, engineer, for certain improvements in weaving machinery. November 2; six months.

John Slate, of Wandsworth, Surrey, accountant, for improvements in stoves and furnaces, and in chimney-pots and regulators. November 2; six months.

John Tatham and David Cheetham, of Rochdale, Lancaster, machine-makers, for certain improvements in the manufacture of cotton and other fibrous materials and fabrics composed of such materials. November 2; six months.

Richard Clyburn, engineer to the firm of D. Maclean and Son, of St. George-street East, Middlesex, for improvements in wheel carriages. (Being partly a communication.) November 2; six months.

James Black of Edinburgh, machine-maker, for a machine for folding. (Being partly a communication.) November 7; six months.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., Fleet-street, patent-agents, for improvements in railways. (Being a communication.) November 7; six months.

William Fairbairn, of Manchester, Lancaster, civil engineer, for improvements in cranes and other lifting or hoisting-machines. November 7; six months.

William Crane Wilkins, of Long-acre, Middlesex, engineer, for an invention for lighting and in apparatus for light-houses, signal, floating, and harbor lights. November 7; six months.

Samuel Edwards, James Ansell, and Patrick Heyns, of Shadwell, Middlesex, engineers, for cer-

tain improvements in obtaining and applying motive power, and in pumps. November 7; six months.

George Frederick Morrell, of Fleet-street, London, gentleman, for improvements in obtaining and applying motive power, and also in pumps. November 7; six months.

John Alexander Lerew, of Boston, America, gentleman, for certain improvements in sewing-machines. November 7; six months.

Benjamin Guy Babbington, of George-street, Hanover-square, Middlesex, Doctor of Medicine, for improvements in preventing incrustation of steam and other boilers. November 7; six months.

Robert Clare, jun., of Exchange-buildings, Liverpool, gentleman, for improvements in the manufacture of metallic casks. November 7; six months.

John Robinson, of Stepney, Middlesex, engineer, for improvements in lifting and moving fluids and other bodies, and in apparatus for steering ships and other vessels. November 7; six months.

David Christie, of St. John's-place, Broughton, Salford, Lancaster, merchant, for improvements in machinery or apparatus for preparing, carding, spinning, doubling, twisting, weaving, and knitting cotton, wool, and other fibrous substances, also for sewing and packing. (Being a communication.) November 7; six months.

Robert Lucas, of Farnival's-inn, London, mechanical draughtsman, for improvements in telegraphic and printing apparatus. (Being a communication.) November 7; six months.

Thomas Main, of the Strand, printer, for improvements in printing machinery. November 8; six months.

James Rock, jun., of Hastings, Sussex, coach-builder, for certain improvements in carriages, which are also applicable, in whole or in part, to other machinery. November 9; six months.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for improvements in the manufacture of candles and night lights. November 9; six months.

James Scott, of Falkirk, N. B., shipwright, for certain improvements in docks, ships, and apparatus connected therewith. November 9; six months.

Sir Francis Charles Knowles, of Lovell, Bucks, Bart., for improvements in the manufacture of charcoal. November 9; six months.

Lucien Vidie, of 14, Rue du Grand Chantier, Paris, France, French advocate, for improvements in measuring the pressure of air, steam, gas, and liquids. November 9; six months.

Joseph Nye, of Mill Pond Wharf, Old Kent-road, engineer, for improvements in hydraulic machinery, parts of which improvements are applicable to steam engines and machinery for driving piles. November 12; six months.

George Robins Booth, of London, engineer, for improvements in the manufacture of gas. November 12; six months.

Peter Spence, of Pendleton, Manchester, manufacturing chemist, for improvements in the manufacture of alum and certain alkaline salts, and in the manufacture of cement, part of which improvements are applicable in obtaining volatile liquids. November 12; six months.

Edwin Clark, of Palace New-road, Middlesex, civil engineer, and Henry Mapple, of Child's Hill, Hampstead, for improvements in electric telegraphs, and in apparatus connected therewith. November 12; six months.

Henry Medhurst, engineer, in the employ of Messrs. Shears and Sons, of Bankside, Southwark, for improvements in gas meters. November 12; six months.

Etienne Masson, of Place St. Michael, Paris, gardener, for improvements in the preparation of certain vegetable alimentary substances for the provisioning of ships and armies, and other purposes where the said substances are required to be preserved. November 12; six months.

John Ball, of Ashford, Kent, engineer, for improvements in applying heat to bakers' ovens and their appendages. November 12; six months.

Henry Wimshurst, of Limehouse, Middlesex, ship-

builder, for improvements in steam engines, in propelling, and in the construction of ships and vessels. November 12; six months.

Charles Marsden, of Kingsland-road, Middlesex, engineer, for improvements in scissors and thimbles. November 12; six months.

William Duckworth, of Liverpool, coffee merchant, for certain improvements in the manufacture of chicory, with certain improvements in the machinery or apparatus for the manufacture thereof. November 14; six months.

Thomas Shore, of Exwich, Devon, miller, for an improved method of dressing flour. November 14; six months.

Robert Howarth, of 61 Chapman-street, Oldham-road, Manchester, for improvements in machinery for raising a nap on cotton, wollen, silk, and other fabrics. November 14; six months.

Abraham Haley, of Frome, Somerset, machinist, for certain improvements in looms for weaving. November 14; six months.

Edward David Ashe, of Brompton, Middlesex, Lieutenant in Her Majesty's Navy, for a new or improved nautical instrument or instruments applicable especially amongst other purposes to those of great circle sailing. November 14; six months.

John Swindells, of the firm of Swindells & Williams, of Manchester, and Juce, near Wigan, manufacturing chemist, for certain improvements in obtaining products from ores and other matters containing metals, and in the preparation and application of several such products, for the purpose of bleaching, printing, dyeing, and color making. November 14; six months.

Joseph Conrad Baron Liebhaber, of Paris, France, for improvements in blasting rocks; also in working marble and stone, and in preparing products therefrom. November 14; six months.

Charles Alemand, of Paris, France, gentleman, for an improved apparatus for producing light. November 14; six months.

Thomas Coats, of Ferguslie, Paisley, Renfrew, Scotland, thread manufacturer, for certain improvements in turning, cutting, and shaping wood and other materials. November 16; six months.

Joseph Martin, of Liverpool, Lancaster, rice miller, for improvements in machinery and apparatus for cleansing and otherwise treating rice and certain other grains, seeds, and farinaceous substances. November 16; six months.

Thomas Allan, of St. Andrew's-square, Edinburgh, printer and publisher of the "Caledonian Mercury," for certain improvements in electric telegraphs, and in the application of electric currents for deflecting magnets and producing electro-magnets. November 16; six months.

William Laird, of Liverpool, Lancaster merchant, and Edward Alfred Cowper, of Handsworth, Warwick, engineer, for improvements in machinery for loading and discharging certain descriptions of cargo in ships and other vessels, and in the construction of such vessels. November 16; six months.

John Hosking, of Islington, Middlesex, engineer, for certain improvements in valves applicable to pumps, and also in apparatus to regulate the pressure and flow of water, air, and through pipes. November 19; six months.

Thomas Duron, of Windsor Bridge Iron Works, Pendleton, near Manchester, Lancaster, engineer, for improvements in machinery and apparatus for moving engines from one line of rails to another, and for turning them; also for compressing certain substances, and for raising and lowering heavy bodies. November 19; six months.

Paul de Tolstoy, of Paris, France, General in the service of His Majesty the Emperor of Russia, for improvements in dredging machines. (Being a communication.) November 19; six months.

Clement Augustus Kurtz, of Manchester, Lancaster, practical chemist, for improvements in dyeing. (Being a communication.) November 19; six months.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman, for an improved com-

position applicable to the coating of wood, metals, plaster, and other substances which are required to be preserved from decay, which composition may be also employed as a pigment or paint. (Being a communication.) November 19; six months.

Robert Brown, of Liverpool, Lancaster, plumber, and brass-founder, for improvements in the application of pumps for raising and forcing water. November 19; six months.

Henry William Ripley, of Bradford, York, dyer, for improvements in dressing and finishing piece goods. November 19; six months.

John James Greenough, of the Strand, Middlesex, gentleman, for improvements in the construction of chairs, couches, and seats, parts of which improvements are also applicable to various purposes where springs for supporting heavy bodies and resisting sudden and continuous pressure are required. (Being a communication.) November 21; six months.

James Bendall, of Woodbridge, Suffolk, machinist, for improvements in certain agricultural implements. November 23; six months.

George Shepherd, of Holborn-bars, London, civil engineer; and Charles Burton, of the same place, operative chemist, for certain improvements in the means or appliances used in conveying telegraphic intelligence between different places. November 23; six months.

Christopher Nickels, of York-road, Lambeth, Surrey, gentleman, for improvements in the manufacture of woollen and other fabrics. November 23; six months.

John Hamilton, of Prince's-square, Glasgow; and John Weems, of Johnstone, Scotland, for improvements in warming and ventilating buildings and structures. November 25; six months.

Henry Duncan Preston Cunningham, of Bury, Hants, paymaster and purser in the Royal Navy, for improvements in reefing sails. November 30; six months.

Frederick Bonaparte Anderson, of Gravesend, Kent, optician, for certain improvements in spectacles. November 30; six months.

Robert Olddis Banks, of the firm of Banks, Brothers, of Wierhouse Mill, Chesham, Bucks, and 20, Piccadilly, London, paper-makers and card-makers, for improvements in the manufacture of paper. November 30; six months.

Francis Frederick Woods, of Pelham-terrace, Brompton, Middlesex, builder, for improvements in paving. November 30; six months.

John Ainslie, of Alperton, Middlesex, now residing at Perry-hill, Sydenham, Kent, draining engineer, for certain arrangements and apparatus for the manufacture of bricks, tiles, and other articles made from clay and other plastic substances, parts of the said arrangements and apparatus being applicable to the treatment and preparation of earths, minerals, animal and vegetable matters. Nov. 30; six months.

James Augustus Elmslie and George Simpson, of Union-buildings, Leather-lane, Holborn, importers of quicksilver and tin-foil manufacturers, for improvements in sheathing ships and in protecting and confining gunpowder and certain compounds thereof, and in the materials used for such purposes. November 30; six months.

Henry Potter Burt, of the Blackfriars-road, Surrey, civil engineer, for improvements in the manufacture of window-blinds. November 30; six months.

William Henry Ritchie, of Kennington, Surrey, gentleman, for improvements in stoves. November 30; six months.

Joseph Eugene Chabert, of Paris, France, for improvements in machinery for washing and drying linen and other fabrics. November 30; six months.

Richard Barber, of Hotel-street, Leicester, late cotton-winder, for improvements in the manufacture of reels for reeling and stands for reels, which improvements are applicable to the manufacture of desk or wafer-seals. November 30; six months.

Henry Jules Boril, of Boulevard Poissoniere, France, engineer, for improvements in the manufacture of bricks. November 30; six months.

Charles Rowley, of Birmingham, manufacturer, for improvements in the manufacture of dress pins and other dress fastenings and ornaments. November 30; six months.

Richard Blakenore, of the Leys, Ganerew, Hereford, Esq., M. P., for improvements in the construction of ploughs. November 30; six months.—*London Mechanics' Magazine*.

NOTICES AND CORRESPONDENCE.

MR. EDITOR:—I have read with interest the communication of "W." on Iron Railroad Bridges, in the first number of your Magazine; and as the subject of iron structures is likely to be one of increasing interest, any facts (if they are such) touching the particular cases cited by your correspondent, may be useful to those who, like myself, are seeking after truth, and may suggest new views, and possibly induce an explanatory article from your valued correspondent.

First fact. The lower chords of the iron bridge which gave way on the Erie Railroad were found to be unbroken, on examination after the fall. Now, if the lower chords of the Rider bridge did not break, though the bridge fell, can your correspondent "W." explain from what cause it could have fallen, and whether the effects of heat, to bind the bridge between two abutments, may not have had something to do with its fall? Your correspondent "W." says: "Again it has been argued, that the excessive heat of the season crippled the bridge; and this opinion has led to distrust of the material used, viz., iron. Admitting this to have been the fact, although unsupported by any evidence whatever, what would the action have been?"

The argument which was used, was simply that the abutments upon which *this particular bridge* rested did not allow sufficient room for the expansion of the iron structure, and this argument is supported by the written report (one season before) of a supervisor of bridges on the Erie Railroad, calling attention to this very matter (want of room for the bridge), which is on file in the company's office.

Second fact. The Whipple iron bridges on the Newburgh branch of the Erie Railroad proved quite defective in point of strength, so much so as to require their being propped up, to secure safety while passing over. Can your correspondent explain this failure of a bridge he has represented as possessing all the requirements of a properly proportioned structure?

N. H.

New Haven, Jan. 15, 1851.

We had supposed "W." to have been acquainted with the facts in the above case. He has shown, we think, pretty conclusively, that in the Rider bridge the lower chord or tie (usually the weakest part of a bridge, and which was the only part subjected to investigation by him) was entirely too weak to meet the strain to which it was exposed. If the bridge gave way elsewhere before the tie parted, it only goes to show that there were parts of the bridge *still weaker than the tie*. The hour of the day at which the bridge fell might throw some light upon the question, whether the heat of the sun had any thing to do with its fall; our impression is, it occurred quite early in the morning.

It is hoped "W." will explain the circumstances connected with the propping of the Whipple bridge on the Newburgh Branch. The fact that they are *now* propped up amounts to nothing; as the Whipple bridges near Binghamton, referred to in the communication of "W.," and shown by him to possess ample strength, are also propped up, *because they are built of iron*.

"*Light*."—The Drummond Light, the Gurney or Bude Light, the French Light (so called at present), and H. M. Paine of Worcester, Mass., are, we believe, the lights of the age. The first is the oxy-hydrogen—the union of oxygen and hydrogen gas or lime. The second is the oxy-oil—a jet of oxygen being introduced into the centre of an oil-wick flame. The third, or French Light, is produced by a stream of hydrogen gas on fine platinum gauze. The fourth, H. M. Paine, is making a deal of noise in the world, but, as yet, not much light. He has lately taken an ingenious and highly scientific method of testing the value of his discovery, viz., by offering to bet \$5,000 that he can perform what he asserts.

We have but little doubt that he believes he has discovered something, and we have as little doubt that he is profoundly ignorant of what it is exactly. We extract from the April number of the Civil Engineer and Architect's Journal, 1849. The italics are ours:

"*The Electric Light.*—Mr. Henry M. Paine, of Worcester, Massachusetts, informs the *Scientific American* that he has discovered a means of generating light, by mechanical action, from water and lime. Mr. Payne says:—I have continued the experiment at intervals, and I am now enabled to announce a *successful result*. I have produced a light equal in intensity to that of 4,000 gas-burners of the largest bat's-wing pattern, with an apparatus occupying 4 square feet of room, at a cost of 1 mill per hour, the current of electricity being evolved by the action of the machinery wound up with a common lock key, and the only materials consumed are water and lime. I am now engaged in making an apparatus for public exhibition, which will be completed this winter, and all its parts submitted to public inspection, except the interior of the generator. This apparatus I will exhibit one year, at the end of which I will make public the mechanism of the generator."

Can any one inform us whether and where this pledge was redeemed? His various statements, for some years past, have proved of such a character as to forbid the expectation of light from him. That his machine should *appear* to do certain things, does not surprise us. We recollect, some years since, an exhibitor of perpetual motion in this city would lift his machine from the table, or request spectators to do so from time to time, in order to prove it self-acting. *Lifting the machine around it up.*

There are, in addition to the "great lights," no less than five new modes of producing artificial light now exhibiting in Manchester. First, Mr. Stait's electric light. This gentleman replied to three questions—first, that the cost was trivial; secondly, that he could, with his *present apparatus*, keep up for twelve hours a self-sustaining light, requiring no extraneous aid; and thirdly, that he could with a single battery produce and sustain several lights. On being requested to substantiate these assertions, at his Mechanics' Institution lecture, by simply allowing one apparatus, producing at the least two lights, to remain on the table untouched during the hour or two of the lecture, he declined, saying that he had placed the whole affair into the hands of a highly-respectable committee. This committee has now sat six weeks without presenting any report. For this report, then, we must wait before any decision can be arrived at on the merits of the invention.

The second is Messrs. Hall and Wilson's gas apparatus, consisting of a sheet-iron retort or scoop, charged with canal coal, saw-dust, and coal tar, being placed, the open end entering first, within a common cast-iron retort, leaving half an inch of space between the two for the generated gas to return the whole length of the retort to the ordinary ascending-pipe. The alleged advantages are, the facility of charging and discharging, by wheeling the interior retort to and fro on a sort of truck, and a considerably increased production of better gas. The obvious disadvantages are, loss of illuminating power by passing olefiant gas along a great extent of heated surface, and, as the outer retort must, of course, be hotter than our ordinary coal retorts, it appears certain that both must soon be twisted too much to al-

low of the free passage of the one within the other, where only half an inch play is allowed.

The third is Mr. Skelton's extremely beautiful oil-gas arrangement. A small retort is placed within a cast-iron stove, very much like a gas-cooking stove: the coke is inserted at top, after the removal of a round lid; the oil flows slowly from a box placed above through a narrow pipe into the retort, and the generated gas, after passing through a very minute washer, enters at once into a gas-holder, holding perhaps 300 feet, without further purification. The want of proper condensation produces a frequent choking up of the mains, but the gas itself, as seen in a handsome argand in the gas-house, and in the burners of the drawing-room chandeliers, is extremely brilliant. The very small quantity of gas that can be thus obtained from so costly an article as oil must prevent the use of this apparatus, excepting perhaps in the country-houses of the nobility, where brilliant illumination, regardless of cost, is desired. The patentee is as yet unable to give any information either as to the quantity produced from each gallon of oil, the kind of oil best suited to the purpose, or an approximation to the probable cost.

I now come to the fourth, being Mr. Gillard's hydro-carbon gas, which is made to produce a soft pleasing light, attended with intense heat, by passing through an argand burner, surmounted by a sort of cage, made of fine platinum wire, reaching a little higher than the top of the flame. The moment the gas is lighted, the platinum becomes brilliantly incandescent, and bears the appearance of a globe of white light. If the light be extinguished, and the cage suffered to cool, or even be replaced by a fresh one, and if the gas is turned on within five minutes, or before the end of the pipe and the contained gas is cold, it will burst forth into spontaneous flame the moment it comes in contact with the platinum, thus proving the extreme purity of that substance.

This is a most beautiful philosophical invention, and an elegant light, but whether it can ever be of practical benefit, for purposes of general illumination, must depend upon the two dry questions of cost and of illuminating power. The apparatus consists—first, of a steam-boiler; and secondly, of an ordinary 12-inch gas retort, 5 feet long, each of course requiring a separate fireplace and fuel. The retort bottom is covered with charcoal, a few inches above which passes a $\frac{3}{4}$ -inch steam-pipe, the bottom of which is perforated with several rows of very fine holes. The charcoal being intensely heated, and the steam turned on, the latter is decomposed, forming carbonic acid and hydrogen. Of carbonic oxide we will say nothing, as the patent is for the production of hydrogen; and in all the patentee's own statements he affirms that by means of this apparatus he does succeed in resolving water and charcoal into carbonic acid and *pure* hydrogen. Thus, then, he obtains from every two proportions of water, and one proportion of carbon, two volumes of hydrogen, and one volume of carbonic acid; and for every two parts by weight of hydrogen he has to pass into the purifier 22 parts of carbonic acid, requiring 28 parts of pure lime to arrest their progress. Thus, for the production of this gas, two fires must be kept up, and one-third of the whole by volume, being eleven-twelfths by weight, being noxious, must be neutralized by more than its own weight of lime. It can, therefore, be by no means an inexpensive operation, as there is no coke, or other saleable residuum.

Mr. Wilson, the manager of Mr. Kurtz's works, says that he can obtain 400 feet of gas in an hour from 7½ lb. of charcoal. After leaving the retorts, the gas passes through the ordinary condensers and dry lime purifiers into the holder. We now come to the all-important question, namely, its power of illumination, as compared with coal or canal gas. In the centre of a drawing-room, 30 feet long by 12 wide, hangs a chandelier with three argand burners, and at one end of the room is a branch with two others, each burner consuming 6½ feet to the hour. Each burner gave less light than an ordinary flat flame, consuming but half the quantity of gas.

Mr. Wilson compared the shadow of the gas, pass-

ing through the meter at the rate of 6.4 feet per hour, with that of a composite candle, six to the pound. This was difficult to do with correctness, as the shadows differ so extremely in color that it is impossible to fix a precise point of similitude. Our results varied from a distance of 2 feet 9 inches to 3 feet, the gas light remaining 6 feet 6 inches from the object. Taking the mean of these observations as 34.5 inches against 78 inches, and squaring those figures, we shall find that a Gillard light, consuming 6.5 feet per hour, as indicated by one of West's meters, is equivalent to the light of 5 11 composite candles, or pretty exactly to that of the ordinary flat flame of canal gas consuming 3 feet per hour. Thus, then, the volume of this gas being double that of canal gas, of course the gasholders and street mains will be required to be of twice the present capacity; and it remains to be shown that the cost of an article requiring one-third of the quantity produced, to be removed in lime purifiers, can be so small as to compensate the outlay required to double the gasholders and mains.

The fifth light is Mr. White's hydro-carbon; this has been noticed in the first Number of this Magazine in a communication from Professor Fyfe, and is pretty much the same as Brown's gas in use at the Astor House.

The subject will be examined in a subsequent number.

"C. M." (Pikesville, Md.) His suggestion in relation to the department of "Chemistry applied to the Mechanic Arts," is favorably noticed—would be pleased to learn from him the basis of an arrangement for the furtherance of the object he proposes.

"J. B. A." (Albany) Space cannot be found in this number to answer his queries relative to putting in switches, frogs, &c. Since the receipt of his letter, a book has appeared in Boston, professing to treat of the very subject. Having a high appreciation of the source from whence it emanates, we can recommend it as accurate and reliable, but it is not as practical as we could wish, being too elaborate and fine drawn.

Major Dodd's article on the Theory of Projectiles is not received; we trust to hear from him before the spring opens.

"G." (Steam Valves), is received, and will appear in the next number of the Magazine;—the preparation of the cut having occasioned some delay.

The "*Engineer E. H. T.*" (Carlton), has our thanks for his good wishes in behalf of the Magazine, and his remark, that similar undertakings have failed less from lack of power in the conductor, than from his attempts to lift himself without other *point d'appui* than was afforded by the "spare folds of his own clothing,"—is characteristic. It is needless to add, for the information of our mutual friends, that for too obvious reasons, the attempt were less insane for us than him.

"*Steam.*"—Mr. Wicksteed was the first to introduce the Cornish engine into London, and he deserves great credit for his exertions. The first engine was put up about five years since; the second, which is larger, is named the Wicksteed engine, and is erected at the East London Water Works. It was started to supply water to that company's district in June 1847, and is the largest engine hitherto erected in London; it was designed by Mr. Wicksteed, who is engineer to the company, and was erected under his superintendence. It was manufactured by Messrs. Sandys, Carne, and Vivian, of the Copperhouse Foundry, Hayle, Cornwall. The diameter of the cylinder is 90 inches, the diameter of the pump 44 inches, length of stroke 11 feet, and it pumps 20 imperial barrels at each stroke. When working at the rate of eight strokes per minute, it raises 5,792 gallons per minute, or 8,340,480 gallons per diem, or 84,563,200 imperial barrels per annum. The power, when working at this speed, is 200 horse-power. The main beam is 39 feet long, and weighs 33 tons—it vibrates on a cast-iron main gudgeon 16 inches diameter, and the whole is supported by four columns and an entablature.

ture of cast-iron, designed in the Grecian-Doric style. The plunger with its appendages weighs 43 tons, which mass of matter is raised 11 feet high at each stroke of the engine. The pump-work is supported by two iron girders weighing each ten tons, and is strongly bolted down to a mass of masonry in the foundations. The boilers, four in number, are cylindrical, 34 feet long, 6 ft. 6 in. diameter, with an internal fire-tube four feet in diameter. The diameter of the steam-pipe is 16 inches.

The total weight of the engines, pump-work, and boilers is 414 tons, and the whole cost was £10,000, or £50 per horse-power, or about £24 per ton.

The quantity of coal consumed by this engine, if working at full power night and day, would be 2,000 tons per annum, and the quantity of coals that would be consumed by the best of the ordinary non-expansive engines in doing the same work, would be 4,500 tons; showing a saving in favor of the Cornish engine of 2,500 tons, which at 13s. per ton is £1,625 per annum, or 16½ per cent. upon the price of the engine for coals only.

Explosion of a Chambered Viaduct.—A singular accident occurred at Birmingham on Thursday, the 7th Nov., when the large viaduct on the London and North-Western line, near the station, actually exploded while a goods train was passing, the explosive force, whatever it was, tearing off both sides of the line, levelling the coping, hurling down for the length of about thirty yards heavy masses of earth and stonework, lifting the engine and tender, a weight of about thirty-five tons, as if they had been playthings, and throwing them off the line. The effects produced are thus described by the local journal:—"Huge blocks of masonry, varying from ten to forty tons, pitched to the distance of many yards, had sunk deep into the ground; mounds of earth scattered far and near; masses of freestone, weighing many hundred weights, tossed about like thistle-down. The timbers of 'the lift' had been crushed in and splintered like reeds. The solid stone and brickwork of the arch, for about twenty feet, was shattered and rent; here ragged and torn, there cut off as smoothly as if a chisel had been applied, the posts of the telegraph and the broken wires forming a sort of tracery along the side; and above was the engine, half turned over, swathed in mud and gravel, seemingly as if resting on a mere ribbon. Had it been a light passenger train instead of a heavy goods, there is every probability that it would have been sent reeling over the viaduct." It was computed, that at least 1,000 tons, including the engine, were raised and dislodged by the shock. As to the cause, it is unknown. By some it is believed that an explosion of gas was the cause; but as no flame or light was seen, that idea has been abandoned by many. Others think foul air had accumulated in the cells or chambers and small arches in the viaduct, and that heavy pressure produced the rupture. An explosion of fire-damp, such as exists in coal pits, is also suggested. As so many railway structures have such covered arches, the question is one of anxious interest, and demands a searching investigation. The damage, meantime, is being rapidly repaired by Messrs. Branson and Gwyther.—*Builder*.

Explosion of a Piston.—The following are the particulars of the exploding of a piston at the steam-engine factory in H. M. dock-yard, Woolwich, England, by which a laborer lost his life: "The piston was an old one, about 34 inches diameter, which had been at work for several years; it was brought into the shop for the purpose of having the rod taken out, which was secured in its place by a nut on the top of the cone, instead of a key, a recess being cast in the top of the piston to receive the nut. The piston was cast hollow, the metal at top and bottom was 15-sixteenths thick, two holes were cast in the top side of the piston for the purpose of taking the air off the core when being cast. These were filled with plugs ground in to make them steam-tight; the core had been allowed to remain in, and of course

completely filled what we may term the *hollow* space inside. It being found impossible to remove the nut, from its being corroded on its place, the piston was taken outside the factory door, and a fire of wood kindled round it for the purpose of expanding the nut and loosening it; the piston was laid on its edge with the end of the rod on the ground. About half an hour after the fire was kindled, the piston exploded with a tremendous report, the concussion breaking all the windows in the vicinity. The bottom was blown completely out, the fragments flying with great force against a building on the opposite side, shattering some of the window-frames and sills, and making deep indentations in the brick walls. One of the pieces went through an open window, and smashed one of the rafters of the roof. The remaining part of the piston, containing the rod, was thrown several yards from where it was lying, and in its progress so severely injured a man, who was standing near it, that he died a few minutes after being taken to the hospital; another man who was also standing by was slightly injured.

"It did not appear, from the appearance of the piston after the explosion, that the core had been in the slightest degree damp; but, if it had contained water, the piston was not raised to a sufficient temperature to generate steam to produce such an effect."

Monument to Christopher Columbus.—A tardy justice, it seems, is to be rendered to this great man, even in his native country. Two of the first men of Spain have taken the lead in this enterprise: Messrs. Martinez de la Rosa and Salvador Bernudez, both known as men of letters and liberal politicians. A subscription has been started for the purpose, which is fast receiving the names of persons of every rank. The situation for the colossal monument has been most appropriately chosen on an elevated spot of Palos de Magner, opposite the convent of St. Ann, whence Columbus started on his first adventurous expedition for the New World. The plans and designs for the monument will be subjected to a competition of all Europe, and Mr. Bernudez will undertake an especial trip to England for those purposes. The preliminary arrangements hint at a colossal statue twenty feet high, and groups surrounding it, forming a base of forty feet in circumference. The statue to be of the finest Florentine bronze, and the pedestal of reddish granite. The lowest estimate of the Columbus monument is £20,000. As the brother of Columbus long dwelt in London as an agent of Christopher's for the purpose of proposing the plan to Henry VII., there is some ground for sympathy here in the monument to the memory of the great discoverer.—*Architect*.

Glass Shades.—The largest ever produced was lately blown at Birmingham by an English workman. It is 62 inches by 26½ inches in diameter, and contains nearly 40 lbs. of metal. Until lately, a Frenchman was considered the most skillful workman in the employment of Messrs. Chance, in whose manufactory the shade alluded to has been blown. This man earns no less than £9 a week, according to a correspondent of the *Daily News*, who gives the dimensions of this monster "shade." A secret in blowing great glass bubbles was lately described in the *Builder*. It consists simply in moistening the mouth with a little water before blowing. The water is converted, in the interior of the drop, into steam, which vastly aids the breath in extending the dimensions of the "bell."—*Builder*.

New Compound of Resin and Lard.—Professor Olmsted read a paper before the American Association for the Advancement of Science, on a new and important compound of resin and lard. It is best made by adding one part of resin, in fine powder, to three parts of lard, and stirring the mass well, without the application of heat. The compound is more easily fusible than lard, running freely at 72°. The addition of resin prevents, in the lard, its tendency to spontaneous decomposition or rancidity. Hence it is valuable for lubricating articles of brass and copper,

such as the barrels of air-pumps, stop-cocks, &c. It may be used, either with or without the addition of black lead, to protect stoves, grates, and iron piping from rust. The new compound forms also an excellent water-proof paste for leather, which does not rub off, and admits of the subsequent application of blacking.

The addition of a small quantity of resin to lamp-oils, greatly increases their illuminating power, and renders them less liable to coagulate.

Dr. Lardner, in his lately-published *Economy of Railways*, thus endeavors to convey to the unpractised reader the enormous speed of a locomotive going at the rate of seventy miles an hour:—"Seventy miles an hour is, in round numbers, 105 feet per second—that is, a motion in virtue of which a passenger is carried over 35 yards between two beats of a common clock. Two objects near him, a yard asunder, pass by his eye in the 35th part of a second; and if 35 stakes were erected by the side of the road, one yard asunder, the whole would pass his eye between two beats of a clock; if they had any strong color, such as red, they would appear a continuous flash of red. At such a speed, therefore, the objects on the side of the road are not distinguishable. When two trains having this speed pass each other, the relative velocity will be double this, or 70 yards per second, and if one of the trains were 70 yards long it would flash by in a single second. To accomplish this, supposing the driving-wheels 7 feet in diameter, the piston must change its direction in the cylinder ten times in a second. But there are two cylinders, and the mechanism is so regulated, that the discharges of steam are alternate. There are, therefore, 20 discharges of steam per second, at equal intervals; and thus, these 20 puffs divide a second into 20 equal parts, each puff having the twentieth of a second between it and that which precedes and follows it. The ear, like the eye, is limited in the rapidity of its sensations, and sensitive as that organ is, it is not capable of distinguishing sounds which succeed each other at intervals of the twentieth part of a second. According to the experiments of Dr. Hutton, the flight of a cannon ball was 6700 feet in one quarter of a minute, equal to 5 miles per minute, or 300 miles per hour. It follows, therefore, that a railway train, going at the rate of 75 miles per hour, has a velocity of one-fourth that of a cannon ball; and the momentum of such a mass moving at such a speed is equivalent to the aggregate force of a number of cannon balls, equal to one fourth of its own weight."

Nova Motive.—At the Polytechnic Institution is a new mode of propulsion being now demonstrated, which, under this title, consists of a series of carriages travelling along with their own motor, in the form of a tube, which is flexible and air-tight. This tube has a series of side valves, entirely under the care of a guard, who, by levers, has a perfect control over his train. The application is very ingenious, and is the invention of a mechanic. Along the whole line of railway is laid a pipe of any given diameter, in connection with which a series of pistons are fixed between the rails intended to receive the tube above mentioned in its passage. In these pistons are atmospheric valves opening into the fixed pipe, which is always kept exhausted, so that, when the train passes over the pistons, the side valves in the tube are opened by means of inclined planes communicating with other levers, which levers are raised up on the train passing. The atmosphere existing in the tube consequently rushes from the tube to supply the vacuum, and the train is impelled by external atmospheric pressure. The inventor, Mr. Weston, with several other practical mechanics, formed into a society, called the Inventors' Protection Society, has executed the illustration of a system by which the inventor states great saving may be accomplished. —*London Illustrated News*.

On the Preservative Influence of Chloroform, by M. Augendre.—M. Augendre, assayer in the mint, at Constantinople, has written to the Academy with a view to point out a new property of chloroform, which might be turned to valuable account under certain circumstances as an antiseptic. Although ether presents many analogous relations to chloroform, it entirely differs from it as to this last named property, for a piece of beef or other flesh placed in a vial, in which a few drops of ether had been poured, putrefies within a few days; whilst the same flesh suspended in a vial, in which a few drops of chloroform had been placed, remains perfectly sweet and untainted; a 1-300th part of chloroform is sufficient to preserve animal substances from putrefaction for an indefinite length of time. M. Augendre has also succeeded in preserving vegetables, such as ananas, &c., for a long time by the same means.

M. Augendre is of opinion that the action of the chloroform in all the cases is purely a physical one, consisting in a contraction of the fibre, or of the parachyma, which is immediately induced,—a contraction which expels the juices, and thus prevents putrefaction. The author concludes his communication by stating as a fact worthy of notice, that the most powerful antiseptics we are acquainted with, such as the chlorides of sodium, zinc, and mercury, and the chloride of formyle, are all chlorine compounds, and that they act on organized substances without yielding up any of their constituent principles to these substances.—*Patent Journal*.

On Working and Modelling in Plastic Ivory, &c.—Madame Rouvier's process is as follows:—"Take the waste turnings of ivory, bone, horn, &c., and steep them in a vessel containing a weak acid solution. Nearly all the acids will do for this purpose, but the following are preferable—muriatic, nitric, tartaric, acetic, citric, and oxalic, also phosphate of lime. The solution is placed in a water bath, at a temperature of 35° to 40° C. (95° to 104° Fah.), in order to obtain complete liquefaction. It is then passed through fine muslin, and about one-fourth of the quantity of ivory gelatine is next added, to absorb the solvent. When the paste is well prepared, the excess of liquid, and any foreign gases, are removed by means of an air-pump,—it thus becomes homogeneous, membranous, and very close. In this state it would be difficult to run it for use; for this purpose it must be dissolved in copal or lac varnish, and in this state it may be run into moulds. When the paste is in the moulds, it may be made to undergo pressure, to expel the air and prevent the formation of air bubbles in the interior. Coloring matters may be added to the paste.—*Id.*

Divisibility of Matter.—A remarkable instance of the divisibility of matter is seen in the dyeing of silk with cochineal, where a pound of silk, containing eight score threads to the ounce, each thread 72 yards long, and the whole reaching about 104 miles, when dyed with scarlet does not receive above a drachm additional weight, so that a drachm of the coloring matter of the cochineal is actually extended through more than a 100 miles in length, and yet this minute quantity is sufficient to give an intense color to the silk with which it is combined.—*Quarterly Journal of Agriculture*.

Lens for Lighthouses.—Mr. Wilkins, the light manufacturer, of Long Acre, has just taken out a patent for a new form of lens for lighthouses, which he denominates "An Improved Reciprocating Dioptric Light Apparatus," which is so constructed that by making one half a fixture, and the other half to revolve, he gets the same reflecting power, at a very considerable less cost.

Bank Note Inks.—The ink for printing bank notes in London is made from the calcined leaves and seeds of grapes, and forms one of the finest and darkest imprints that can be found.

APPLETONS'

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VOL. I.]

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Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 3.]

MR. SAMUEL'S CONTINUOUS EXPANSION STEAM ENGINE.

Fig. 1.

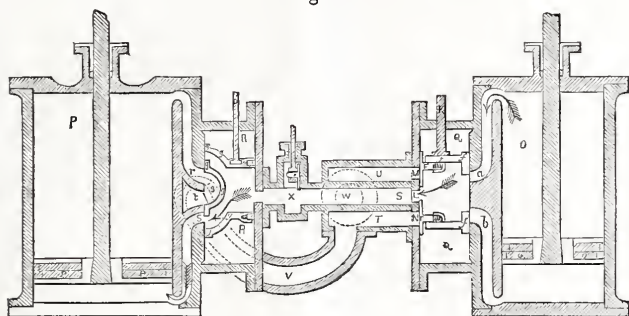


Fig. 3.

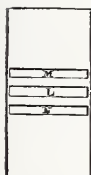


Fig. 2.

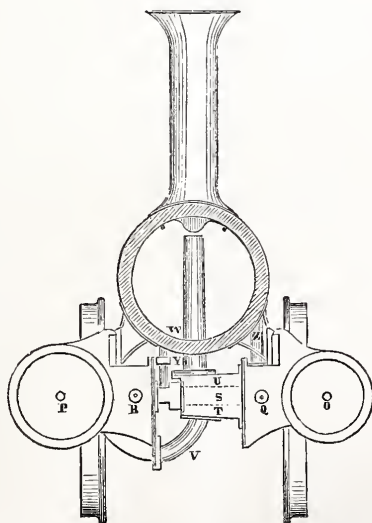


Fig. 6.

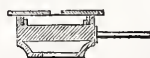


Fig. 5.

Figs. 7, 8.



Fig. 4.



MR. SAMUEL'S CONTINUOUS EXPANSION STEAM ENGINE.

Specification.

My improvements in the construction of steam engines have for their object the economizing of steam and fuel. For this purpose I construct my improved steam engines with their cranks placed at right angles with each other, or nearly so, and with two or more cylinders, and I cause a portion of the steam admitted into the first cylinder to pass into the second; and if more than two cylinders be used, I cause the steam to pass to each of the cylinders in succession for the purpose of giving motion to their pistons respectively.

And in working an engine constructed according to this part of my invention, after the supply of steam admitted from the boiler into either end of the first cylinder for producing one stroke of the piston has been cut off (which I prefer to do about the middle of the stroke), I open a communication between that end of the first cylinder and the end of the second cylinder, from which the piston thereof is to be impelled; and the expansive force of the steam will thus be made not only to continue the motion given to the piston of the first cylinder for the residue of its stroke, but also to give motion to the piston of the second cylinder in the required direction.

The communication between the two cylinders being then cut off, the expansive force of the steam which has been admitted into the second cylinder will complete the stroke of the piston of that cylinder; after which this steam may be admitted into a condenser, or into the chimney of the engine for producing a blast, or the steam, or a portion of it, may be conducted from the second cylinder to a third cylinder, for the purpose of giving motion to a piston in like manner as the steam has been conducted from the first cylinder to the second.

The stroke of the piston in the first cylinder occasioned by the admission of steam from the boiler into one end of that cylinder, as already mentioned, having been completed, I open a communication between the boiler and the opposite end of the first cylinder, so as to admit steam and produce a stroke or motion of the piston of that cylinder, in a direction contrary to that already mentioned, and I cut

off the supply of steam from the boiler in like manner as before; I then open a communication between the last-mentioned end of the first cylinder and that end of the second cylinder from which its piston is now to be moved, and the expansive force of the steam will then not only continue the motion given to the piston of the first cylinder for the residue of the stroke, but also give motion to the piston of the second cylinder in the required direction. This second communication between the two cylinders being then cut off, the expansive force of the steam contained in the second cylinder will complete the stroke of its piston: after which the steam may be admitted into a condenser, or otherwise disposed of, as already mentioned. These motions may of course be repeated and continued as long as the engine may be required to work.

By this mode of passing or regulating the passage of steam from one cylinder to another, the whole, or nearly the whole of the expansive force of the steam acting against each of the pistons is exerted in the directions in which the pistons are respectively intended to move.

In figs. 1 and 2 I have shown a mode of applying this part of my invention in the construction of a railway locomotive engine.

Fig. 1 is a horizontal cross section of parts of such a locomotive engine, showing the application of my improvements thereto, the section being shown as taken through the centres of the two cylinders.

Fig. 2 is an end elevation, showing the cylinder end of a similar locomotive engine which has been constructed with improvements according to my invention. In these, and some of the other figures, stuffing boxes, screw bolts, and other well-known parts are omitted, as not being necessary to be shown for the explanation of the descriptions of this part of my invention, or the applications thereof.

O is one of the cylinders, which I will call the first cylinder, furnished with a piston *o* and piston-rod, as shown in fig. 1; also two steam ports *a* and *b*, but no exhaust port. P is another cylinder which I will call the second cylinder, similarly furnished with a piston *p* and piston-rod, and I prefer in every case to make the

second cylinder of a greater diameter than the first.

Q is the steam-chest attached to the cylinder O; Z (fig. 2) is the steam pipe; R is a chest attached to the second cylinder, similar in form to the chest Q, but used chiefly to protect a valve which works within it.

S X is a pipe along which steam is communicated from either end of the first cylinder through the steam-chest Q, and the opening L, in the steam-chest cover, to the second cylinder. T U is a chamber or chest, surrounding the pipe S X; V is the exhaust pipe for conveying the steam ejected from the second cylinder to the blast pipe or chimney; *f* is a hollow slide valve, which works in the steam-chest Q, motion being given to it by means of the rod K. This valve is made in two parts, with a telescope joint or slide, and furnished with spiral springs to keep the faces or sides of the valve close up against the side or face of the cylinder O and the steam-chest cover, a plan of which cover is given in fig. 3.

Fig. 4 is a section of the valve *f*, and the several parts of the same valve are shown separately in figs. 5, 6, 7, and 8. Fig. 5 is a plan of the face of the valve, which works against the face of the cylinder; fig. 6 is a plan of the opposite side of the same part of the valve, showing the opening, into which is fitted a telescope joint or slide as before mentioned, and this opening is also shown in the section, fig. 4.

Fig. 7 is a plan of a plate, upon the back of which there is a ring which fits into the opening shown in fig. 6 just mentioned, so as to form a joint or slide, and the outer face of the ring works against the steam-chest cover, an opening L being made through the cover into the pipe S X.

Fig. 8 is a side view of the ring or packing represented in fig. 7, showing the slide which fits within the orifice shown in fig. 4, so as to make the telescope or slide joint before mentioned.

I have not shown in the figures already mentioned any steam pipe for conveying steam immediately from the boiler to the cylinder P, but I prefer to furnish that cylinder with such a pipe and a stop cock, so that if it should become desirable (more particularly at the time of starting the engine) to work that cylinder by

means of steam direct from the boiler, the steam pipe may be used in the ordinary manner for that purpose.

The fig. 1 shows the piston *o* of the first cylinder O, when it has nearly reached the bottom of a downward stroke, or stroke towards the bottom of the cylinder, the steam from the boiler having been cut off at half stroke, and the piston *p*, of the second cylinder P just commenced an upward stroke—being propelled from the bottom of its cylinder by steam passing from the upper side of the piston *o*, in the cylinder O, through the pipe S X, into the bottom of the cylinder P. As the piston *o* of the cylinder O descends further down that cylinder, the valve *f* will ascend, and the upper port, *a*, of the same cylinder will be opened to such an extent as to admit the passage of a free supply of steam along the pipe S X to the cylinder P. The further ascent of the valve *f* will close the opening L in the pipe S X, and confine the steam which has passed through that opening in such a way as to compel it to act expansively upon the bottom of the piston *p*, and propel it upwards.

When the piston *o* has reached the bottom of its downward stroke, or nearly so, the valve *f* will have ascended so far as to admit the steam remaining above the piston in the cylinder to pass through the opening M and pipe U, into the blast pipe, or chimney W, shown in fig. 2, and by dotted lines in fig. 1. The steam which has passed into the cylinder P, will act expansively and propel the piston *p* upwards, and as the rod of that piston is connected with a crank placed at a right angle with the crank of the rod of the piston *o*, the piston *p* will move upwards rapidly during a space of time in which the piston *o* has, comparatively speaking, very little motion. And when that piston has arrived at the top of its upward stroke, the valve *q*, will have moved downwards to such an extent as to open a communication by means of the concavity *o* in the valve Q, with the exhaust-pipe V, leading to the blast pipe, by means of which, the steam which has performed its office in the cylinder P, is ejected into the blast pipe or chimney. Immediately after the piston *o* has arrived at the bottom of its downward stroke, the upward motion of the valve *f*, will have uncovered the port *b*, leading

from the steam-chest Q, into the lower part of the cylinder O, by means of which the piston *o o* will be propelled towards the other end of the cylinder so as to make an upward stroke of the piston, and (steam from the boiler being cut off at half stroke) by the time that the piston *o o* has proceeded a little beyond its half stroke, the communication through the opening L will be again opened, and a portion of the steam which is now propelling the piston *o o* will escape from the lower port of the cylinder O, pass along the pipe S X, and the position of the valve *q* having now been altered, so as to close the lower port of the cylinder P, and open the upper port of it, the piston *p p* will be propelled towards the bottom of that cylinder. The motion of the valve *f* will then again cause the opening L to be closed, and at, or a little before the completion of the upward stroke of the piston *o o*, a communication will be made through that valve, and the opening N, so as to allow the steam remaining below the piston *o o* to pass along the pipe T into the blast pipe or chimney; the steam confined by the closing of the opening L will afterwards by its expansive force cause the downward stroke of the piston *p p* to be completed in like manner as its upward stroke was made, and the upper port of the cylinder P being then opened by the passing of the valve *q*, the steam contained in that cylinder will pass through the upper port *r* of that cylinder, and through the concavity *q* into the pipe V, and the blast pipe in like manner as before described.

[An engine which has been constructed on this plan, and been some time at work, has, we understand, given hitherto great satisfaction—particularly as regards the saving of fuel effected by it, which is stated to be something quite extraordinary.—ED. M. M.]

GLASGOW'S IMPROVEMENTS IN MACHINERY
FOR SHEARING, SHAPING, PUNCHING, AND
COMPRESSING METALS. *Enrolled July*
12th, 1850. Manchester, Eng.

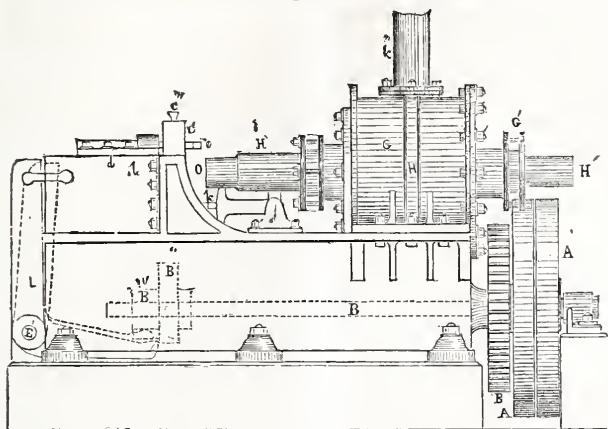
The contents of this specification relate, first, to a mode of operating on metals by means of dies, punches, or other tools, actuated by the force of steam transmitted directly through the piston and piston rod of a steam cylinder, with-

out the intervention of shafts, wheels, pulleys, or other mechanical agents, usually employed in conveying and distributing such power.

Secondly—To a machine for forming screw-nuts, by cutting and shaping the iron and punching the holes at one operation.

The improvements of the patentee under the first head, are exemplified by a drawing and description of a machine, in which they are applied to the purpose of forming rivet or bolt heads by the compressing action of a die. In the contrivances hitherto adopted for this purpose, the power has been transferred from the engine by the ordinary shafts, drums, and straps, of the factory, to machines adapted to maintain and regulate the action of the dies and cutters, and to effect the various other movements necessary for the purpose, by means of suitable combinations of levers, cams, and wheel-work. Independently of the loss of power attendant on the application of such machinery, and other disadvantages, it is found that the sudden stoppage of the motions of such machines, consequent upon the forcible impact of the die upon the metal, is apt to cause great derangement of the working parts, to break the teeth of the wheels, and strain the machines generally, thus causing the necessity of frequent repair, and much consequent delay and expense. To obviate these evils is the object of the first part of the present invention. The engraving represents, partly in profile, and partly in section, the patentee's improved machine for making rivets, spikes, or bolts. The process whereby this is effected comprises four movements or operations. The first is, the cutting off or separating a portion of the rod iron of the precise length required for the rivet or bolt proposed to be made. The second is the placing of the iron so cut off in the proper situation to receive the action of the heading die, and retaining it there during such action. The third is the application of the heading die to the piece of iron, so as to cause the formation of a head thereon, by the compression of the metal under the die, and the retiring of the die so soon as its office has been discharged. The fourth is the removal of the piece of iron so headed from the receiving die in which it has been secured and sustain-

Fig. 1.



ed while undergoing the compressing action of the heading die. A, A, are fast and loose pulleys to receive the driving strap, and are keyed on the same shaft with the pinion, not shown in the engraving, which drives the spur-wheel, B¹; B, is a shaft, passing lengthwise through the middle of the machine, carrying the spur-wheel, B¹, which is driven by the pinion before mentioned, and carrying also the cams or tappets, B² and B³, by its rotation these are caused to act on a vertical sliding plate, C, and a cranked lever, L, respectively, in the manner hereafter explained. C, is the upright sliding plate, placed transversely in the machine, and moving in perpendicular guides. The upper part of this sliding plate contains a recess, for the reception of the receiving die, which is to hold the iron while operated on by the heading die. The receiving die is a plate, whose thickness is equal to the length of the shaft of the bolt or rivet to be manufactured, having in its centre a circular perforation of the same diameter as the shaft of the proposed bolt or rivet. It fits into the cavity or recess formed to receive it in the sliding plate, C. In the inner circumferential face of this cavity, a groove is sunk, which passes quite round it, and communicates by a perpendicular aperture with the cup or funnel, C³, inserted into the top of the sliding plate, C. There is also a communication between the highest part of this groove and the front side of the sliding

plate, by a horizontal aperture. The object of this arrangement is to prevent the die from becoming too much heated, by the continuous application of a stream of cold water, admitted from the cup or funnel, C³. The water is brought from any convenient reservoir, and conveyed by a pipe in a regulated stream to the funnel, C³, through which it descends into the groove before mentioned, and filling this completely surrounds the die. The groove being full, the water overflows by the horizontal passage, and is distributed over the outward face of the die, thus maintaining a constant check against the heating of the die by the contact of the iron. An alternating vertical motion is communicated to the sliding plate, C, by the cam or tappet, B², the form of which is such that the sliding plate will pause or dwell at each of the extreme points of its range during an interval equal to about one-sixth of a revolution of the shaft, B. On the top of the framing, behind the sliding plate, C, a cradle or block, d, is secured and adjusted by bolts. It is traversed lengthwise by a guiding groove, through which the heated iron is conducted to the cutting apparatus, which consists of a cutter, d², placed in front of the cradle, d, and firmly fixed thereto by bolts or screws. The cutter consists of a steel plate having an aperture, whose lower edge is bevelled on the side opposite to the sliding plate, C, so as to present upwards a cutting edge in close contact with the posterior surface of the re-

ceiving die fixed in the sliding plate. The axis of the guiding groove coincides with the centre of the receiving die, when the sliding plate is in its highest position, so that a rod of iron passed down the guiding groove, will be conducted through the hole in the cutter, and also through that in the receiving die. To prevent the further advance of the rod, when it has passed so far, that the part of it projecting beyond the receiving die will afford sufficient metal for forming the head of the rivet or bolt, a stop or rest, *e*, is placed immediately before the receiving die, supported by an arm, whose position is capable of adjustment by set screws. The distance of this stop from the cutter determines the length of the piece of iron to be cut off for forming the proposed bolt or rivet. The heated iron being introduced into the recess of the receiving die is brought, by the downward motion of the sliding plate, into forcible contact with the edge of the cutter, *d*², and a portion of it sheared off, which remains in the recess of the receiving die, and is lowered by it to the place where it is to undergo the compressing action of the heading die. During the latter operation, it is prevented from being forced out of the receiving die by the sliding punch or jingler, *l*, the end of which closes the circular hole or recess in the receiving die which carries the iron. This sliding punch or jingler, and the mode of its operation, will be more particularly adverted to hereafter. *G*, is a steam cylinder, provided with stuffing-boxes, *G*¹, *G*¹, through which the rods, *H*¹, *H*¹, of the piston work. The cylinder, *G*, has a steam-chest, *K* (not seen in the drawing), within which is a slide or other valve, for admitting steam to each side of the piston alternately. The movements of the valve are controlled by a bell crank lever arm, or handle, *k*, the opposite arm of which lever is connected by links with the valve rod. There is a steam pipe, not seen in the drawing, which conveys steam to the steam chest; and also a waste or exhaust pipe, *K*². The extremity of one of the piston rods is provided with a die, *o*, fitting into a socket, suitable to form the head of the bolt or rivet in process of manufacture. The axis of the piston rod, and the centre of this heading die, coincide with the axis of the sliding punch or jingler, *l*, and with the centre of the receiv-

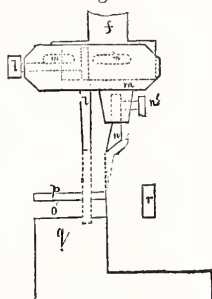
ing die, when the sliding plate is in its lowest situation, so that on steam being admitted behind the piston, the heading die, *o*, advances and the compressing movement takes place. The piece of iron in the receiving die being prevented from retiring, by the end of the jingler, *l*, which closes the cavity of the die, is compressed endwise, and the portion of it which projects beyond the face of the receiving die, spreads under the pressure, and forms the head, according to the shape of the heading die. The valve being now reversed by the handle, *k*, steam is admitted on the opposite side of the piston, and the heading die withdrawn, leaving the finished bolt or rivet in the recess of the receiving die, from which it has to be dislodged by the movement next to be described. The cam or tappet, *B*³, on the shaft, *B*, actuates the horizontal arm of the elbow lever, *L*, which vibrates on its fulcrum at *L*¹. The extremity of the vertical arm of this lever is connected with the sliding punch or jingler, *l*, by links. The jingler moves in a guiding tube in the cradle or block, secured and adjustable by bolts to the framing. The tappet, *B*³, occupies such a position on the shaft, *B*, relatively to the cam or tappet, *B*², which regulates the motions of the sliding plate, *C*, that during the time that the process of compressing the iron by the heading die is going forward, the lever, *L*, maintains the position shown in the drawing, and the jingler, *l*, closing the recess in the receiving die, bears the pressure of the rivet or bolt end, until the head is complete. But just before the sliding plate, *C*, ceases to be stationary in its lowest position, the tappet, *B*³, depresses the horizontal arm of the lever, *L*, thereby causing the vertical arm to assume the position shown in the dotted lines, and forcing forward the jingler, which enters the hole or recess in the receiving die, and ejects the finished bolt or rivet therefrom. The continued rotation of the shaft, *B*, then causes the tappet, *B*², to raise the sliding plate, *C*, to its first position, in readiness to repeat the process. The mode of using the machine is as follows:—The main shaft, *B*, being put in action by connection with some prime mover, the operator introduces the heated end of the rod of iron from which the bolt or rivet is to be cut into the guiding groove in the cradle, *d*.

The sliding plate, C, having arrived at its highest position, the rod is pushed forward until its progress is arrested by the stop or rest, *e*. The tappet, B², continuing its revolution, now causes the sliding plate, C, to move downward. In its descent, it presses the rod forcibly downwards upon the edge of the cutter, *d*², and thereby cuts off a portion of the rod of the requisite length, the distance of the stop, *e*, from the cutter, *d*², being regulated according to the length of iron required for making the bolt or rivet. This done, the operator returns the rod to the furnace, to be ready for the next operation, and the sliding plate, C, having reached its lowest position, brings the receiving die carrying the piece of iron exactly opposite to the heading die, *o*, on the extremity of the piston rod. While the sliding plate, C, remains stationary in this position, owing to the dwell in the tappet, B², the after steam-port is opened by means of the handle, *k*, and steam admitted behind the piston, by which the heading die, *o*, is driven forcibly against the portion of the rod projecting beyond the face of the receiving die, and by the pressure exerted on it, causes it to spread within the cavity of the heading die, and thus form the head of the rivet or bolt. The piece of iron is retained in the receiving die during this operation by the end of the jingler, *l*, which sustains the pressure exerted endwise on the iron, and prevents it from being driven out of the die. The valve being now reversed, steam is admitted on the opposite side of the piston, and the heading die withdrawn, while the shaft, B, continuing to revolve brings the tappet, B², to bear upon the horizontal arm of the elbow lever, L, and by depressing it, causes the jingler, *l*, to discharge the rivet or bolt from the recess in the receiving die. The tappet, B, then comes again into action, and raises the sliding plate, C, to its first position, ready to recommence the operation. It is evident that by the application of suitable cutting or stamping tools or dies, and by varying the construction and form of the parts wherein the compression takes place, the above machine may be adapted to a great variety of operations where compression or the forcible application of cutting, punching, or stamping instruments is required. A variety of these applications are indicated

by the patentee, as well as some modifications involving variations in other parts of the machine. By one of these he proposes to effect the periodical opening and closing of the steam valve by means of eccentrics or tappets, deriving motion from the shaft, B, and by another, to leave open one end of the cylinder, and place the steam chest in communication with the condenser, so as to impel the piston by atmospheric pressure.

The machine which constitutes the second part of this invention, is for effecting the shaping and punching of iron, for the formation of screw-nuts in an improved and economical manner. A treble-armed lever shaped thus , vibrates on a fulcrum, supported by pillars over a bench or anvil block. The vertical arm of this lever is of considerable length compared with the others, which extend horizontally from the fulcrum on each side. The extremity of this vertical arm is connected with any prime mover, which

Fig. 2.



imparts to it an oscillating or vibratory motion from side to side, thus alternately raising and depressing the short horizontal arms. To the extremity of each of the latter is attached a vertical rod, which moves up and down in guides, being alternately raised and lowered by the motion of the short arm of the lever, to which it is attached. The lower end of this rod carries the shearing and punching apparatus, the arrangement of which will be more easily understood by reference to fig. 2; *f*, represents the lower end of the rod; this is enlarged into a block containing a socket for the reception of the shank of the punch, *l*, which is retained therein by the set-screw, *l'*; *m*, is a box, for carrying the cutter, fitting on the block, and

secured thereto by bolts, which pass through slots, m' , m^1 , by means of which the position of the box on the block may be varied so as to regulate the distance of the cutter, n , from the punch, l . The box, m , also has a socket, in which the shank of the cutter, n , fits, and is secured by the set-screw, n^1 ; q , is a bottom plate, secured to the bench or anvil block; p , is a cover, inclosing the guiding channel through which the iron is to be passed, and both it and the bottom plate, q , have holes to allow the free passage of the punch, l ; the cover, p , and bottom plate, q , terminate in a face, which nearly coincides with the path of the cutter, n ; r , is a stop piece, fixed in any convenient manner to the framing, and so adjusted that its distance from the edge of the cutter, n , is equal to the diameter of the nut to be made. The machine works as follows:—The rod, f , derives a slow rising and falling motion from the reciprocating lever with which it is connected, and carries with it the punch and cutter, n and l , as before explained. The machine being thus in action, the workman takes a bar of flat iron of the proper section, which has been previously heated in an adjoining furnace, and inserts its heated end into the channel, o^1 , pushing it along the same until its progress is arrested by the stop, r . The rod, f , then descends, severing a portion of the rod by the cutter, n , and punching a hole in the end of the remaining portion of it, by the punch, l . When the rod, f , rises, the iron is again advanced, until it encounters the stop, r . The rod, f , again descends, repeating the shearing and punching operation, as before, and it will be perceived that the piece cut off by this last descent of the rod will have a hole through its middle, while the remaining portion of the iron will have had another hole pierced in its extremity, which is to form the next nut. The piece of iron or nut separated by the cutter falls down between the bottom plate, q , and the rest or stop, r , and is removed by an attendant, to be completed by tapping, in the usual manner. The heated bar of iron is again advanced, and the operation repeated, and another piece of iron, suitably perforated, is cut off. In this manner, the process is continued, and it will be perceived that the distance between the stop, r , and the cutter, n , being made equal to the diam-

eter of the bar from which the nuts are cut, the nuts will be square; the cutter, n , being adjusted so that its distance from the centre of the punch, l , is equal to half the diameter of the bar of iron, the holes will be pierced in the middle of the nuts. By altering the form of the cutter, six-sided or other nuts may be produced. In practice, several of the above described apparatus are ranged side by side, having the upper extremities of their vertical levers connected to the same prime mover, as to combine a number of them into one machine.

The patentee states that he does not claim any of the well known parts whereof the machines described are composed, but only the particular combination and arrangement thereof described, and claims:

Firstly—The mode indicated of applying the expansive force or pressure of steam, air, or other elastic fluid, to actuate suitable tools, machinery, and apparatus for shearing, shaping, punching, and compressing metals, by means of the direct action thereon of a piston rod and piston, moving within a cylinder, under the influence of said steam, air, or other elastic fluid.

Secondly—The general mechanical arrangements of the machinery herein described, and of all modifications thereof, under whatever varieties of form, or mode of application, so long as the essential and distinctive characteristics of the invention be retained.—*Patent Jour.*

BUILDING FOR THE GREAT EXHIBITION.

We present a few of the details of the construction of this building from the Drawings exhibited at a Meeting of the Society of Arts in the Adelphi, at which Mr. Paxton read to the Members a paper descriptive of his design, with its history as gradually developed in his own mind, after the many years' experience he has had in the erection of buildings of a similar nature, though on a very minute scale as compared with this giant superstructure: this fact, that the design of the construction is the result of years of study and experience,—and not, as is imagined by those who hear Mr. Paxton's name mentioned for the first time, some sudden flight of theoretical genius,—must tend greatly to satisfy the public mind upon the question of its stability; a question, which the extremely light ap-

pearance of its construction, when compared with its vast extent, is liable to suggest to all of us.

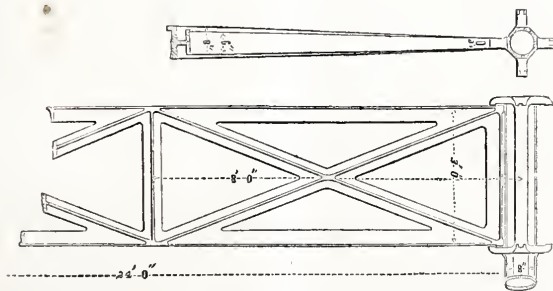
The first remarkable character that is observed in examining the building is the uniformity existing through all the parts of the construction, so that the whole is made to consist of a repetition of the same detail over and over again. If we examine a plan, we shall observe a centre aisle, 72 feet in width, extending the whole length of the building; on either side occur aisles 24 feet wide, then next 48 feet, next again 24 feet, then 48 feet, and outside of all 24 feet; total width being 408 feet. The pillars supporting the roofs over the several aisles are all exactly similar; they are surmounted by girders, over the 24 and 48 feet spans, 3 feet in depth; the additional strength for the wider span being obtained by the girders being of wrought iron, while the others are of cast metal. We subjoin a sketch of the cast girder, showing the method of attachment to the pillar. The 72-foot girder is of wrought iron, 9 feet 6 inches in depth, divided by Queen-posts, and double diagonal trussing, or lattice-work; this has a camber of $9\frac{1}{2}$ inches.

The ends of the girders rest upon troughs laid along the top of the transverse girders: these troughs convey the water to the columns, down which it falls, and is carried off by pipes laid below the flooring. This arrangement prevents any liability of the roof being flooded, as the extreme distance that any portion of water has to be conveyed by the troughs is 24 feet; and to each superficial area of 24 feet square the column forms a pipe to carry off the water.

The Paxton girders are placed 8 feet apart, so that each cast-iron girder supports two of them, and the wrought-iron girder four.

In the accompanying sketch of the cast-iron girders, Fig. 1 is a plan and Fig. 2 an elevation: the top of the column is given for the purpose of showing the mode of attaching the girders. To all the columns, except those at the very outside, 4 ends of girders have to be attached, for which 4 upper and 4 under lugs are cast on the top of the column. These lugs have projections on their interior surfaces, between which and corresponding projections on the upper and under surfaces of the beam, there is space sufficient

Fig. 1.



for a key, and by it the girder is made a fixture to the column in direction of its length. In order to fix it transversely there is a projection and recess on the under side on the girder and lug, and a key is driven in on the upper side, longitudinal recesses being made to receive it in the lug and girder. In fixing the girder it is lifted to the height of the lugs, then slid into its position sideways, and the keys driven into their places.

The wrought-iron girders are on the trussed principle, and, for the sake of uniformity, of the same depth as the cast-

iron ones. The upper web consists of two pieces of light angle iron, about 5×3 inches; the lower web of two pieces of flat iron $\frac{1}{4}$ thick and five inches deep. The vertical stretching pieces occur every 8 feet, and are of double T iron; and diagonal straining pieces, 5 inches by $\frac{1}{4}$, are fixed in the 8 feet spaces, and riveted between the two angle irons of the upper web and the flat bars of the lower web.

The ridge and furrow form of the covering is the great novel feature in the building, and Mr. Paxton has devoted much attention and trouble to bring it to

Fig. 3.

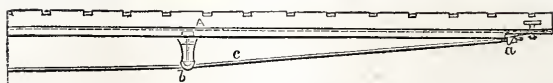


Fig. 4.

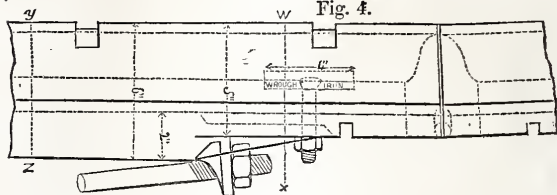


Fig. 5.

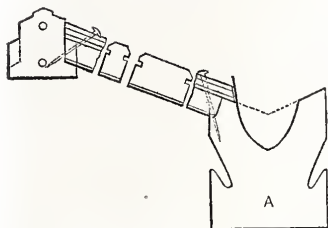


Fig. 6.

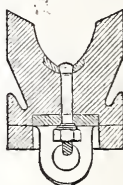


Fig. 7.

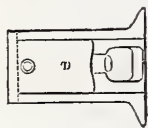
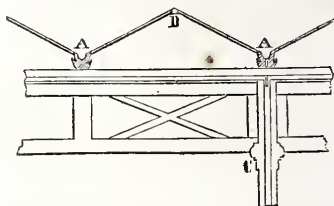


Fig. 8.

Transverse View of Ridge-and-Furrow Skylight.



its present complete style. The span (or width between the Paxton girders) is 8 feet, and the pitch such as to make the inclination of the glass $2\frac{1}{2}$ to 1. The panes of glass are 50 x 10; so that between the top of the ridge and bottom of the furrows is one piece of glass, and thereby all unsightly joints are dispensed with. The glass weighs 16 oz. per foot.

For the foundation on which the whole building rests, a hole is sunk in the ground under each column, three feet deep, and about the same across each way: this is filled with concrete to within six inches of the surface; the end of the column has a foot cast on it 18 inches long by 12 broad: this rests on the surface of the concrete, and it is considered unnecessary to have any thing to prevent the column being shifted on its base horizontally, the weight upon it being considered sufficient to prevent such an accident.

The roof of the exhibition building is glazed with English sheet glass, the rafters being continued in uninterrupted lines the whole length of the building. The transept portion, although covered by a semi-circular roof, is likewise on the angular principle. All the roof and upright sashes being made by machinery, are put together with great rapidity, for, being fitted and finished before they are brought

to the place, little more is required than to fix the finished materials in the positions intended for them. The length of sashbar is stated by Mr. Paxton at 205 miles. The quantity of glass is about 900,000 feet, weighing 400 tons.

On each of the longitudinal wrought-iron framed girders is laid a gutter, and upon and communicating with this, four transverse gutters and plates, on which are laid the sashbars of the four ridge-and-furrow roofs and glazing. The water falling on the glass is carried to the transverse gutters in the furrows, thence to the longitudinal gutters on the girders, and so down the hollow columns of the building to the bases, whence it is carried off by 6-inch cast-iron water pipes.

The glass made use of is English crown, 50 inches long, 10 inches wide, and $\frac{1}{16}$ -

Fig. 9.—Lower portion of Exterior.

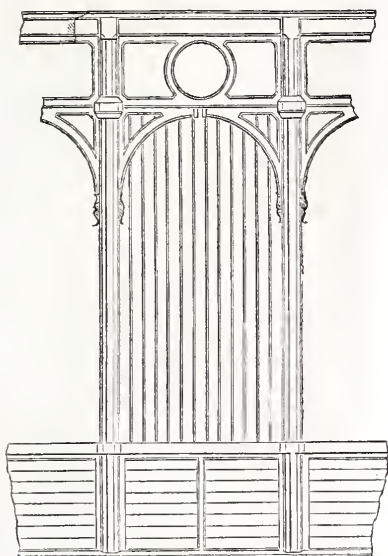
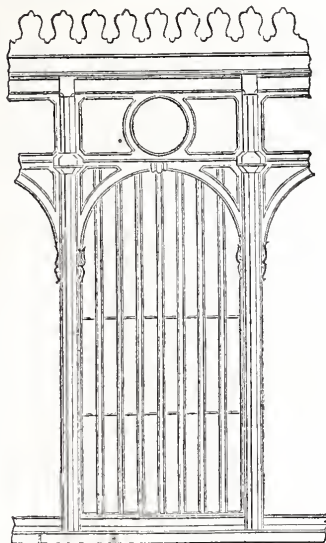


Fig. 10.—Upper portion of Exterior.



inch thick, running from the ridge-piece to the gutter-plate. The object of this length is to do away with overlaps.

The transverse trussed gutter-plates or troughs are cut out of solid fir-scantling by machinery before they are brought on to the building. These transverse gutter-plates are trussed with wrought-iron rods, bent in the form shown, which can be screwed up or slackened by nuts at the end.

Fig. 3 is half length of the transverse gutter-plate A, the whole length being 24 feet, width 5 inches, and depth 6 inches. On the lower part of the gutter-plate is seen the tension rod, *c*, 1 inch in diameter, secured by a nut and screw-plate at *a*, and passing through the eye of the queen bolts, *b*. The but-ends of the gutter-plates, as shown in fig. 4, are likewise brought together, and fixed in a cast-iron shoe, with an aperture to carry the water down into a square trough.

Figs. 5, 6, and 7, are enlarged views of the gutter-plate. Fig. 4 is a side view, showing the ends of the tension rods, with the nut and screw, and cast-iron plate fixed to the underside of the gutter-plate, of which fig. 6 is a view of the underside, and fig. 7 a transverse section of the gutter, showing the end of the

tension rod, and how the plate is fastened to the timber.

Fig. 5 is another transverse section of the gutter at *y*, *z*, and also of the skylight, showing the wooden bar of the skylight and the ridge. The ridge is worked by machinery out of solid deal 3 inches square, and the butting-joints have $\frac{1}{2}$ -inch dowel 3 inches long. The ordinary skylight-bars are $1\frac{1}{2}$ inch deep by 1 inch wide, shown in the small section, with a $\frac{1}{4}$ -inch groove on each side to receive the glass. The other small section shows the form of other intermediate skylight bars called string-bars, which are $2\frac{1}{2}$ inches wide by $1\frac{1}{2}$ inch deep. It will be perceived by the section, that the skylight-bars frame into the ridge, and are notched on to the trough gutter, being secured at the top and bottom by 3-inch nails. For the purpose of taking off any condensation forming within the building which may run down the glass, a groove is provided worked on each side of the gutters.

The skylights are 8 feet span, and have an incline of $2\frac{1}{2}$ to 1.

Fig. 8 is a transverse view of one of the ridge-and-furrow skylights.

Figs. 9 and 10, elevations of the exterior, showing the two stories, the lower being closed with boarding, and the upper glaz-

ed. The base, to the height of 4 feet, is fitted with luffer boarding, with the view to ventilation.

If the several details be carefully examined, it will be discovered there are several contrivances to save labor and facilitate fixing. It will be interesting to observe, that in matters so common and so commonplace, there was yet room for the exercise of research and ingenuity.



THE BRIDGE FAILURE AT THE SOUTH-EASTERN STATION, LONDON BRIDGE.

Experience is only true and valuable so far as it is on an extended basis, for though called so, that is not experience which is merely local and partial. We are not always called upon to reproduce the same model or work on the same lines; but our practice is chiefly in the extension or particular application of existing examples. It therefore becomes of the greatest importance that we should have as wide a collection of facts as possible, so as to enable us more safely to calculate the result of any new direction, new application, or further extension; so, indeed, as to secure us from experimenting too far. We want, therefore, not only examples of success, but of failure; we want especially to know where any principle has been strained too much, that we may avoid such extreme, and where any detail has proved defective, so that we may apply the proper remedy. It has therefore always been considered, by our best authorities, as most expedient to record failures. Thus Smeaton prefaces the history of the Eddystone Lighthouse. We have therefore felt it highly desirable to report, as accurately as it is possible, a few particulars as to the failure of the Bridge over Joiner-street, at the carriage entrance to the South-Eastern Railway Offices of the London Bridge Station, which took place on the 19th October last.

The bridge is of a peculiar construction, and consists of six compound girders of cast and wrought iron, patented by Captain Warren. The annexed engraving, fig. 1, shows part of one of the girders, rather more than half of the length; and fig. 2, a transverse section of the roadway and two of the girders. There are in all six girders, placed 11 ft. 6 in. apart. The girder that broke is 41 ft. 6

in. long, and consists of a series of triplet cast-iron triangles, with a connecting-rib along the top and bolted at the joints, but there is no connecting-rib along the bottom of the girder; instead of which, they are held together by a horizontal tie, consisting in width of four wrought-iron bars, 6 inches deep by $1\frac{1}{4}$ inch thick and 13 feet in length, coupled together by $4\frac{1}{2}$ inch bolts passing through a boss cast on the triangular stays, and also bolted to the intermediate triangles.

The cast-iron triangles are 4 feet deep, with a rib cast on the top 6 inches deep, making the whole height of the girder 4 ft. 6 in., and the length of the triplets 13 feet; the section of the cast-iron is T-shaped, $5\frac{1}{2}$ inches wide on the back, and the depth the same; the thickness of metal 2 inches.

On the top of the girders are laid cast-iron plates, 11 ft. 6 in. long, with ribs bearing at each end on the girders; on these plates rest the materials which form the road, as shown in fig. 2. It must be observed, that the horizontal tie-bars are not intended to act as suspension bars; they are merely connected at the abutment piers to the ends of the cast-iron triangles. The point at which the bridge failed is marked with the letter *f*, where one of the cast-iron stays broke asunder, and also the top rib, as shown in fig. 3, which is an enlarged view of the triangle which failed. It was only 5 feet from the abutment. Shown at *F*, fig. 1, and *f*, *f*, *f*, fig. 3.

Various statements have been made as to the cause of the failure. It was stated that the accident was caused by the girder being loaded with a large stack of bricks; but this is doubted, as the stack was at the opposite end.

The stack of bricks bearing on the girder was 11 feet square and 5 ft. 6 in. high, equal to 666 cubic feet, which will give, at 72 feet to the thousand, between nine and ten thousand bricks, or a weight of about 22 tons. Another statement is, that the failure was caused by two carts which were on the bridge at the time; one of them, loaded with bricks, it is supposed passed over some obstacle, and caused the wheel to descend suddenly with great force. Whether this be so or not, we cannot pretend to say; but if the bridge had been properly constructed, with a cast-iron girder 41 ft. 6 in. long,

Fig. 1.

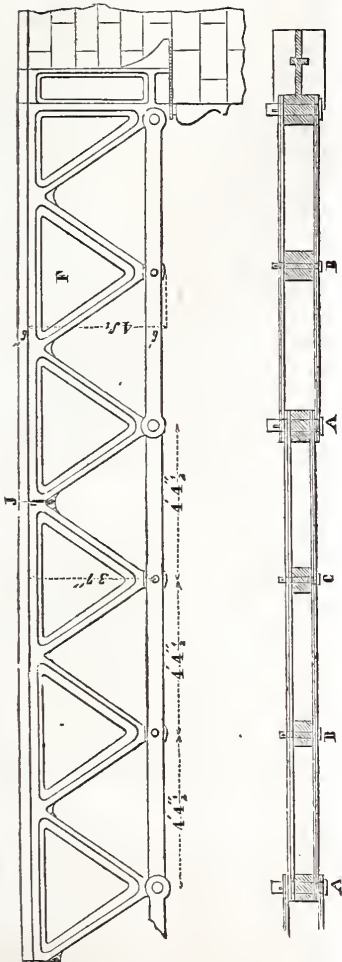


Fig. 2.

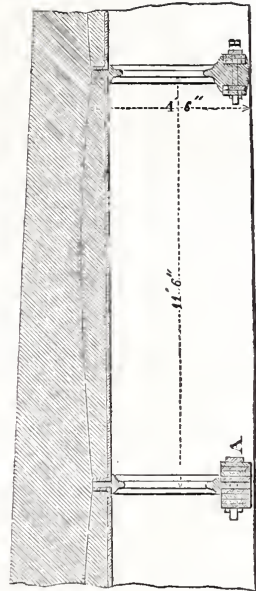
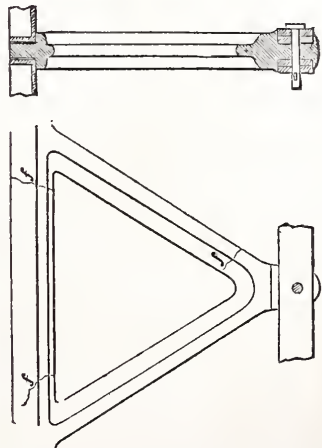


Fig. 3.



and of the great depth of 4 ft. 6 in., it ought not to have broken down with any such force. For ourselves, we are decidedly averse to these compound girders of wrought and cast iron. The contraction and expansion are unequal; and, consequently, the strain must be constantly

varying, while the slightest deflection of the wrought-iron must cause the cast-iron to snap asunder.

The broken rib having been made good, the bridge has been tested with a considerable weight, but with what success we have not been able to ascertain.

SHANNON IRON BRIDGE—GIGANTIC PILE-DRIVING.

A most important fact is recorded in connection with the progress of the Midland Great Western Railway Bridge over the Shannon, in the sinking of cylinders of 10 feet in diameter for the foundations. This has been done with Potts's pneumatic process by Messrs. Fox and Henderson, the contractors, who have likewise, we believe, the working of the patent.

This bridge is, we understand, of iron, and of large dimensions, and is supported entirely on cast-iron cylinders, of the diameter mentioned. The cylinders near the shore have been put down by excavating and the application of weight; but those in the bed of the river, by Potts's process. We need scarcely inform our readers, that in this simple process, an air-pump is employed, which being connected with the head of the hollow pile, the air is exhausted, and a stream of water, sand, shingle, and gravel, rushing up from below, the pile sinks gradually into the displacement made to any required depth. It is therefore a kind of sub-aquatic excavation, the lower end of the hollow pile being converted into a kind of scoop, worked by the air-pump on the platform above. The exhaustion employed was 26 inches of mercury, equivalent to 13 lbs. to the square inch; and the cylinder was driven down between 5 and 6 feet in a few minutes, or rather suddenly, until checked by a piece of submerged or drifted wood. The operations were under the direction of Mr. J. Millnor, C. E., the contractor's engineer; and the bridge abutments, which are of stone, under Mr. Dargan, the eminent Irish contractor. The cylinders will be filled-in with concrete.

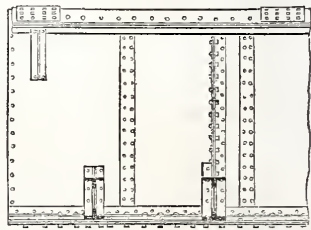
Hitherto the piles employed for Potts's process for sea-beacons, for the Maeldraeth Viaduct, the Black Potts Bridge, and other structures, have been of very small diameter, so that the proceedings we have just described are of the greatest importance. A cylinder of 10 feet diameter gives a large bearing, and four such cylinders will carry a large platform for a pier, and which can be put down without cofferdams or other preparatory works, thereby greatly reducing the expense of submarine foundations. Here neither cofferdams, caissons, steam-

engine pump, nor diving-bells are wanted, only an air-pump of adequate power, which can be easily carried about and rigged anywhere. It will be obvious that unless sunk from the inside (when there would be as much trouble for pumping as by the pneumatic process, and very much labor and expenditure of time), any external application of power would, if it could be employed, exercise a very unfavorable effect on the material of the cylinder. Indeed, a force of much less than 13 lbs. to the square inch would smash a hollow iron cylinder to pieces. Then again it is to be observed, that 10 feet is by no means the limit of the diameter to which the cylinders can be carried, so that it is open to engineers to design works in situations and under economical conditions where hitherto the resources of art were insufficient to meet the emergency.

 PLATE-IRON GIRDER BRIDGES.

The annexed engravings show the construction of one of the bridges designed by Mr. Martin, the engineer, to carry the railway from the London and North-Western Railway to the East and West India Docks. It carries the railway over Randolph-street, Cambden Town.

Fig. 2.—Side View of Longitudinal Girder.



The peculiarity consists in constructing the bridge with two side girders, each of a single web, of plates of iron, 71 feet long, 6 ft. $7\frac{1}{2}$ inches high, and $\frac{5}{11}$ -inches thick; put together with plates 5 inches wide, overlapping the vertical joints, and $\frac{3}{4}$ -inch rivets placed 3 inches apart, and fixed to the top and bottom plates by angle-iron 3 inches wide, and $\frac{3}{4}$ -inch rivets. The bottom plate is 2 ft. 8 in. wide, made with $\frac{5}{16}$ -inch plates in lengths of 8 feet each, with plates overlapping

Fig. 1.—Transverse Section.

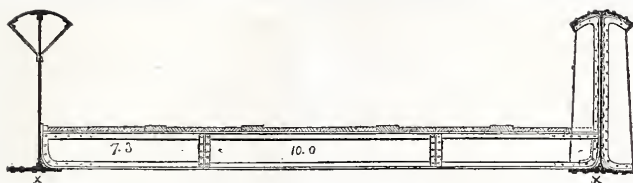


Fig. 3.—Enlarged Section of Girder, showing the Stiffeners.

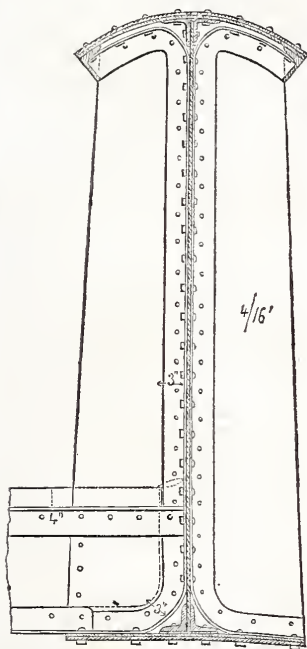
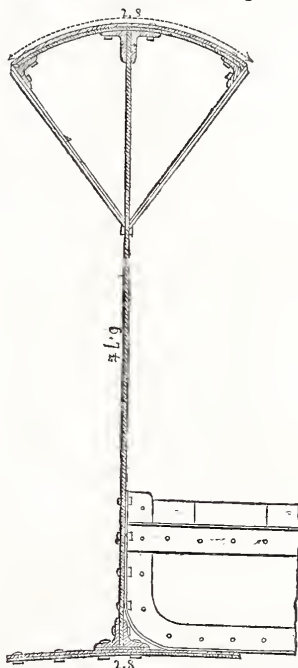


Fig. 4.—Section through Girder, showing the Stays to Stiffen the Top Plate.



the joints 6 in. wide. The outer flange is curved down 1 inch, to throw off the wet; the top plate is 2 ft. 8 in. girt, made with $\frac{5}{8}$ -inch plates, excepting the three middle plates, which are $\frac{3}{8}$ -inch in thickness; the top is curved down 5 inches, and put together with inch rivets. The girders are stiffened by eight vertical plates on each side of the web, of $\frac{1}{8}$ -inch iron, fixed by angle-iron 3 inches wide, and $\frac{3}{4}$ -inch rivets placed 4 inches apart. There are also two similar stiffeners at each end, of $\frac{3}{8}$ -inch iron. The top plate is further stiffened by stays of T-iron, $5\frac{1}{2}$ inches wide between each pair of stiffeners.

The cross girders are 24 ft. 6 in. long and 1 ft. 4 in. high, made with $\frac{3}{8}$ -inch plates in three lengths, and stiffened by angle-iron top and bottom and on each side, $3\frac{1}{2}$ inches wide, and fastened with $\frac{3}{4}$ -inch rivets 4 inches apart. The ends of these cross girders rest upon the two girders first described.

Fig. 1 is a cross section of the bridge. Fig. 2 is a side view of part of one of the longitudinal girders. Fig. 3 is an enlarged section of one of the girders, showing the stiffeners. Fig. 4 is a section through the same girder, showing the stays to stiffen the top plate.—*Civil Engineer and Architects' Journal.*

ARNOT'S VENTILATING APPARATUS IN USE IN THE YORK COUNTY LUNATIC ASYLUM.

Fig. 1.—Plan.

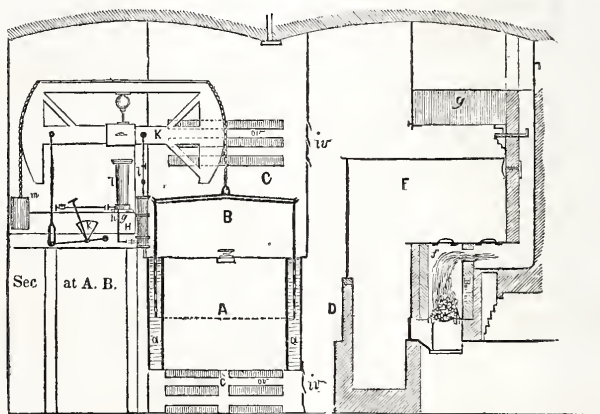
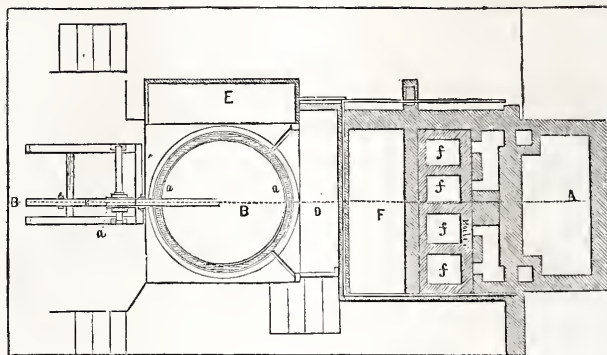


Fig. 2.—Section.

The apparatus is shown in the annexed engravings, of which fig. 1 is a plan and fig. 2 a section, taken through the centre from A to B. It consists of a fixed cylinder, placed in the centre of a room, and which cylinder is about 5 ft. 6 in. diameter and 5 ft. high; with a chamber above and below, each furnished with inlet-valves to receive the air from the fresh-air shaft, and outlet-valves to deliver the air into the adjacent chamber, and thence distributed through the building. The cylinder is made of galvanized iron, is open at both ends, and has an outer case at about 3 inches' distance, and the whole depth of the cylinder filled with water, which forms an annular hydraulic

joint. Within this cylinder is another cylinder, 5 ft. 9 in. diameter, inclosed on the top, similar to the rising bell of a gas-holder; the rim of this cylinder works up and down in the water contained in the annular rim just described. By this arrangement the communication with the upper and lower compartments is cut off.

The working cylinder is suspended to the end of a movable beam about 10 feet long, and balanced by a weight or bob suspended to the other end, equal in weight to the movable bell, minus a sufficient weight to cause the bell to descend and expel the air in the lower compartment. Now, for the purpose of setting the beam in motion, it is necessary to

have some movable power to overcome the friction of the movable parts and the air. For this purpose Dr. Arnot has adopted a single-action water-engine, having a cylinder 2 inches diameter and 12 inches stroke; to be supplied by water from a reservoir placed on the top of the building, 60 feet above the engine. A column of water of this altitude acts with a pressure of about 30 lb. on every movable square inch of the piston; and if the piston be 2 inches diameter, it will be equal in round numbers to 3 square inches, consequently the force of the water acting on the piston will be $3 \times 30 = 90$ lb.; and this is the power with which the Doctor proposes to work the apparatus, and as the engine is single-acting, the cylinder will require about a pint of water for every stroke. Thus, if the engine works 8 strokes per minute, it will require 8 pints of water, or 1 gallon per minute, to keep the beam moving.

This engine is placed so that the connecting-rod is connected with the movable beam at 1 foot from the fulcrum; and if the beam have a radius of 5 feet, and the working cylinder be suspended at the end of the beam, the bell will be elevated 5 feet at every stroke of the engine. When the piston has performed one upward stroke by the pressure of the water, the water is cut off by a slide-valve, and that which is within the cylinder is discharged into an open pipe; consequently, the extra weight of the movable parts will cause the piston to descend, and at the same time the working cylinder will also descend. Now, if we suppose that at the commencement of the working of the apparatus the working cylinder is close down on to the fixed cylinder, the upper compartment will be filled with air, and as it rises it will displace a quantity of air equal in capacity to the cubic contents of the working cylinder, and force it out of the valves that open outwards; and at the same time that the cylinder is rising, the space below is increasing equal in capacity to the cylinder, and a quantity of air rushes in through the valves opening inwards, and fills up the space; and when the bell begins to descend, the lower inlet-valves close and the lower outlet-valves open, and the air that is below is forced out through the outlet-valves of the lower compartment, and at the same time the air is being admitted into the

upper compartment, as before described. By this means the action is double, and a constant stream of air is being taken in through either of the inlet-valves, and forced out through the upper or lower outlet-valves into the adjacent chamber, and thence through trunks and cases to all parts of the building.

Now, it has been shown, that for every stroke of the engine the working cylinder displaces a quantity of air equal to its capacity in both the bottom and upper compartments; and as the capacity of the working cylinder is equal to 125 cubic feet, it displaces in both compartments 250 cubic feet for every upward and downward stroke of the engine, at an expense of one pint of water, descending from an altitude of 60 feet; and if the engine works 8 strokes per minute, it will displace 2000 cubic feet of air, at an expense of 8 pints, or one gallon of water, which is equal to 2,880,000 cubic feet of air, displaced by the aid of 1440 gallons of water for 24 hours. These are the proportions proposed by Dr. Arnot for ventilating York Hospital.

For the purpose of feeding the apparatus, pure air is brought down a shaft, the top of which is considerably above the top of the building, and which communicates at the bottom with the chambers before described; and if it be desired that the air be warmed, it is effected by allowing the air, as it is expelled from the chambers, on its passage to the trunks, to pass between a series of hollow copper vessels filled with hot water.

The adaptation of the water-engine, which Dr. Arnot proposes to adopt, is particularly desirable, as it can be worked at comparatively little expense, and the water after it has done its work in the engine, may be used for domestic purposes. It will also be seen that by this apparatus the whole of the air forced in for ventilation can be accurately measured if a counter be attached to the engine to show the number of strokes the engine has performed during the day.

Reference to Engravings.

Similar letters refer to similar parts in each figure.

A, is a fixed cylinder, open at both ends with outer case *a*, filled with water, forming an annular hydraulic joint.

B, working cylinder inclosed on the top

and open at the bottom; the rim works up and down in the hydraulic joint *a*.

C, C', upper and lower chambers, with inlet valves *i v*, opening inwards to take in the air from the external air-shaft E; and outlet valves *o v*, opening outwards to convey the air to the shaft D, and thence to the building through the trunk T.

F, furnace-room, in which is placed the boiler with four square fire-boxes *f, f, f, f*, to heat the water for supplying the copper cells *g*, when it is required to warm the air as it is being forced into the building; there are several of these copper heating cells placed side by side, with narrow spaces between for the air to pass through.

H, a water-engine, acted on by a column of water on one side of the piston, which is brought by a pipe *h*, from a cistern placed on the roof 60 feet above; *j*, is an air-vessel to prevent concussion by cutting off the water suddenly; *k*, gear for opening and shutting the eduction and induction valves; *l*, piston and connecting-rod.

K, balance-beam; at one end is fixed a chain to suspend the working-cylinder, and at the other end is another chain to suspend a balance-weight *m*.

NEWTON'S IMPROVEMENTS IN COUPLING JOINTS FOR PIPES.

This invention of improvements in coupling has for its object to obviate the necessity of easting lead in the sockets in joining pipes, and the subsequent operation of calking, to render such joints tight. The junction of pipes, according to this invention, is effected by the compression of a soft metal, or other material, round the ends of the pipes to be united, by means of a collar, by which the soft metal is enveloped, and which collar is used for the compression of the soft metal round the abutting ends of the pipes to be united.

The annexed cut represents, in section, pipes connected according to this improvement. The ends of the pipes, *a, a*, have grooves or projections formed on their exterior, and one end of the pipe is furnished with a shoulder, *b*. A belt or hoop, *c, c*, of some soft metal, such as lead, is placed on the junction of the pipes; the exterior of this hoop is of a conical form, adapted to that of the interior of the hard metal collar, *d*. This collar is furnished with an internal flange, which retains the soft metal within the collar during the compression of the metal; the opposing

Fig. 1.

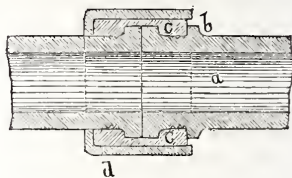
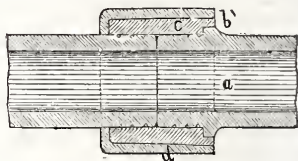


Fig. 2.

force is offered by the shoulder, *b*, which prevents the soft metal, *c, c*, escaping from the interior of the collar. By exerting sufficient force on the collar, *d*, in the direction of the shoulder, *b*, the conical forms of the collar, and soft metal lining that material, will be compressed round the pipes, and into the grooves formed thereon, and will thereby render the junction of the two complete, and perfectly tight. Instead of casting the shoulder, *b*, permanently on one end of the pipe, a loose collar may be substituted, and suitably held during the process of compression, to effect a like object. This loose collar may be applied to the formation of the successive joints required. When the soft metal or other material, *c, c*, is of a soft and plastic nature, the conical form of the ring or hoop, *d*, may be dispensed with, as the endways compression will be found sufficient to effect the desired object. Where greater security of the joint is required, the patentee forms the ends of the pipes with small flanges, as exemplified in fig. 2, the soft metal collapsing on and surrounding the flanges,—the lengths of the pipes are held more securely together. The principal features of the improvement are described as being the simplicity and cheapness of construction, which render these joints very economical.

Secondly—The rapidity with which such joints can be made, the inconvenience of melting lead, and afterwards calking, to make it tight, being avoided. The ease with which the joint may be renewed; affording great facilities for re-

pairing or renewing intermediate lengths of pipes; and the mode of making the joint, rendering it available where the junction has to be effected under water.

The patentee claims, as the invention communicated to him:—

Constructing coupling joints or connections, by surrounding the abutting ends of pipes with a collar, or tube of lead, or other soft metal, or suitable material, so as to form a covering at the point of junction of the two pipes, and forcing over such belt of lead a collar or covering of some unyielding material of the necessary strength, whereby the yielding material will be compressed in the space between the ends of the pipes and the outside pipe or collar, producing the joint required.—*Patent Journal*.

THE VERTICAL TUBULAR BOILER OF THE AMERICAN STEAMERS "ATLANTIC" AND "PACIFIC"—THE INVENTION OF THE EARL OF DUNDONALD.

(From the Franklin Journal for September.)

The success attending the use of this form of boiler in the steamers *Atlantic* and *Pacific*, running from New-York to Liverpool, and the *Osprey*, from this port to Charleston, has called the attention of engineers particularly to the subject; and although, for three years past, boilers of this kind have been gradually coming into use, still it was not until the success of the steamers above named that entire confidence was placed in them for marine purposes. The origin of that which is called new is at all times a matter of interest, and having examined a few works on the subject, I offer some remarks, showing the progress made by the invention since 1825.

[The writer here describes, successively, Eve's apparatus, 1825; Steenstrup's, 1828; Nott's, 1830; Holloway's, 1835; Hall's, 1841; and then proceeds as follows:—]

The Earl of Dundonald patented, Jan. 19, 1843, a boiler, a longitudinal section of which is here shown. (Fig. 13.)

The earl says, "This figure shows a section of apparatus for generating steam for steam engines, constructed according to this part of my invention, and the apparatus is composed partly of tubes or hollow surfaces, the interior of which are open to the water spaces of the boiler, with which the tubes are combined.

Such boiler or outer vessel may be varied in shape so long as there be a chamber as hereafter described, between the furnace and the fire-place and the chimney. K K is a steam boiler, which may be of a square or cylindrical section, or other convenient figure; L is the fire-place, M M M M is a rectangular chamber, there being a number of tubes or hollow surfaces in the upright position, through which the water flows in consequence of the water therein becoming hotter than other parts of the boiler. The heat of the fire passes into the chamber M at N, over the bridge O, at the end of the furnace or fire-place; and the passage P, from the chamber M into the flue or chimney, is situated as low as possible, in order that the greater heat of the vapors may be retained in the chamber M M, for it will be readily understood that the more highly heated vapors or products of combustion will occupy the upper part of the chamber M M, and the draught into the chimney will only carry off the cooler parts of the vapors, the more highly heated being comparatively in a quiescent state, at the upper part of the chamber M; and it is the peculiar arrangement of the chamber M within a steam boiler, when containing tubes or hollow surfaces, and combined with the outlet P into the chimney, so as to leave a considerable space above it (for the more highly heated vapors to be retained in the chamber M), which constitutes the peculiar character of my invention. Z is an opening into the chimney at the upper part of the chamber M M, to facilitate the getting up of a draught when first lighting a fire, it being closed at all other times; Y is a steam pipe in connection with the upper part of the boiler, having a stop-cock; this pipe is drilled with many small holes in the direction towards the chimney, by which numerous jets of steam can be projected amongst the tubes, in order to sweep away the dust and ashes when required. I would remark that it is not necessary to have the tubes in an upright position."

Such is the Earl of Dundonald's account of his invention. This boiler is superior to all that have preceded it, and is identical with those now in use on board the steamer *Osprey*, with the exception that her boilers have not the

Fig. 15.

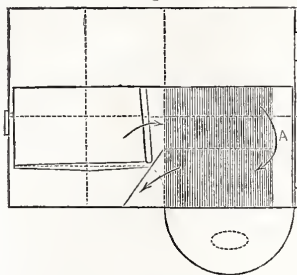


Fig. 14.

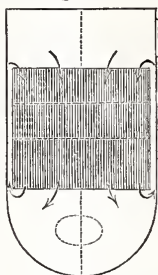
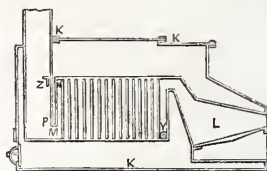


Fig. 13.



opening Z, or the steam pipe Y, both of which would be an improvement. The boilers of the *Atlantic* and *Pacific* differ from the above in having two furnaces, one above the other.

In December, 1845, James Montgomery, of Tennessee, took out a patent for a vertical tubular boiler, which is shown in figs. 14 and 15.

His claim is the arranging the fire chamber or furnace of a tubular boiler at the side, so that the heat shall act on the upper half of the tubes, in combination with the diaphragm, or partition, and flue, to carry off the flame, heated air, &c., to act on the lower half of the tubes after acting on the upper half as described.

He also claims the making of the bottom of the boiler of a conical or dished form, with the mud or blow-off valve in the lowest part of the concavity, in combination with the vertical tubes communicating with the bottom, in the manner described, to permit the deposit of the sediment, there being a water space surrounding them (the tubes), to induce circulation of the water up the tubes and down the surrounding space, to wash the sediment towards the mud or blow-off valve, as herein described.

From the drawing and specification the boiler will readily be understood. Its distinguishing feature is the use of the horizontal diaphragm, which, being placed about midway in the tubes, causes the fire to act as stated. Several of these boilers have been used in steam vessels of moderate size, and for stationary engines; they have given much satisfaction, causing a considerable saving of fuel where they have been used in place of other boilers. Properly constructed, this is a very good boiler, but it has no

advantages over the boiler of Dundonald, and I think the diaphragm plate was introduced to correct an imaginary evil, as, in Dundonald's boiler, the lower end of the tubes can never be overheated.

Previous to this time there had existed much prejudice against tubular boilers of any kind for marine purposes, but the success attending the introduction of horizontal and vertical tubes in England, and the boiler of Montgomery in this country, called the attention of those interested in marine navigation to them; and when the steamers *Atlantic* and *Pacific* were begun under the direction of Mr. E. K. Collins, of New-York, he caused a large number of experiments to be made with vertical tubular boilers for use in salt water. The performance of the steamboat *Jonas C. Heartt*, with Montgomery's boiler, was carefully noted for several days, being equal in time to a trip to Europe.

It being satisfactorily ascertained that the tubes would not choke up, but, on the contrary, would keep perfectly free from scale, Mr. Collins concluded to adopt some form of vertical tubular boiler; but as the form patented by Montgomery was objectionable, from the necessity of returning the heat below the boiler, to unite all in one common chimney, thereby making a flue arrangement not at all satisfactory, he determined to test the use of vertical tubular boilers without the diaphragm plate, being, in fact, the boiler of Dundonald. After a series of experiments, proving that there was no objection, the boilers of the *Atlantic* and *Pacific* were designed by his chief engineer, John Farron, jun.

The only difference between these boilers and those of Dundonald is in the furnaces, which are here doubled, one

being above the other, caused by the necessity of obtaining more grate surface than could be obtained with one range of furnaces, the objection that had been urged against allowing the heat to act against the whole length of the tube having, by experiment, been found to be without cause. It is not necessary to say that these boilers, so far at least, are perfectly successful; the short passages made by these ships attest the fact. At or about the time these boilers were designed, Mr. Montgomery surrendered his patent, and obtained a re-issue, dated August 15th, 1848.

The claims made in this re-issue, and allowed by the examiners at the Patent Office, are in number four. The first claim is for vertical tubes, in connection with a top and bottom chamber, and with side water spaces, made singly or in sections; this covers the boilers of Steenstrup, Hall, and Dundonald. The second claim is for so arranging the furnace outside the tubes that the greatest heat shall be applied at their upper end, and the reduced heat at their lower ends; this claim and method of arrangement appears to be the same as is minutely described by Dundonald in his patent. The third claim embodies the first part of the original patent granted to him; viz., the use of the diagram plate midway in the tubes, as shown in his drawing. The fourth claim is for making the bottom of the boiler conical or dished, in connection with vertical tubes, &c.; this is also a part of Dundonald's patent, for he distinctly states that his boiler may be made cylindrical if desired, which of course gives the dished bottom.

From what has been stated, it will be seen that the vertical tubular boiler has been nearly twenty years in reaching its present position, beginning with the patent of Eve, in 1825, and ending in 1843, with that of Dundonald. I say ending *there*, for I consider that his boiler has all the elements of success. The boiler of Montgomery, as patented in 1845, although equally as effective if properly arranged, has no advantages as regards economy of fuel, and is simply a modification of the vertical tubular boilers that preceded it, although no doubt patented without the knowledge of their existence.

STEAM SAFETY VALVE.

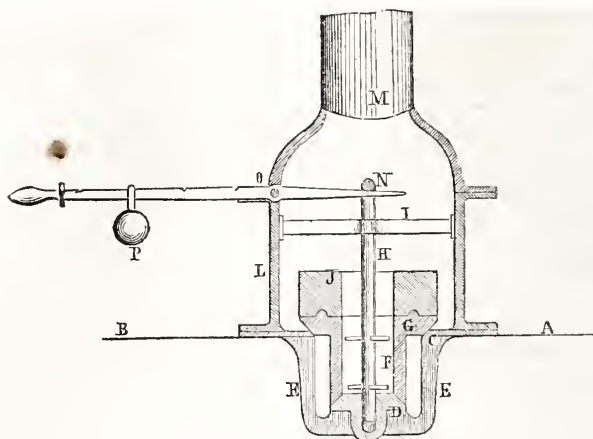
For Appletons' Mechanics' Magazine and Engineers' Journal.

SIR,—Every suggestion towards the removal of an evil, and where the object sought to be obtained is improvement, may justly be considered entitled to passing consideration; for, even should the proposed remedy, on trial, be found imperfect, it may, though not immediately, yet indirectly, contribute, to fashion the *chain* of successful accomplishment, which, for its ingredients, is most frequently composed of numerous, and sometimes only slightly bearing, suggestive *links* or connections.

Under shelter of this introductory observation, I presume to trespass on your valuable space, and present to your readers the description of a safety valve, for steam-boilers, which, in a less perfect form, while resident in England, I made public in No. 1320 of the London Mechanics' Magazine, and now re-submit, through the influence of a similar channel, or kinsman; and in respect to which, I have received the favorable testimony of several eminent engineers.

To the lamentably frequent and serious consequences arising from inefficiency of the safety valve, I need not advert, but may be permitted here, previous to description, briefly to explain the objects of my improvement, or its supposed advantages over valves in ordinary use, which, it is believed, consist, in presenting a more perfect, *easy*, and *governable* form of *expirating valve*, with less tendency to "*stick*" or fail, having all the safety of a "*locked*" valve, without its liability to inefficiency, and combining the conveniences and advantages of a *controllable valve*, but *short* of its exposure to be "*overloaded*," either *wilfully* or through *ignorance*.

To proceed to its description, A, B, in the fig. represents longitudinally, the top, or upper line, of a boiler. C, is the upper, and D the lower valve seat, connected by two or more arms, E, E. F is the valve; it is made of a tubular form, resting at its lower end in the valve seat, D, and having a flange, G, at its top, setting in the valve seat C; constituting, in effect, two valves, of which the upper one is the larger. H is the valve spindle connected by cross pins, or



otherwise, to the valve F: it enters the valve seat D, which, together with a cross-piece, I, serve as guides for the vertical motion of the valve. J is a heavy ring of metal, resting on the flange G. It forms the *maximum* weight which the valve is capable of having put upon it, and that the boiler with *safety* should be allowed to bear. L is an outer case, inclosing the valve, and to it is attached a waste, or "blow-off" pipe, M. N is a pin, or projection at a right angle with, and fitted to, the spindle H. O is a lifting and regulating lever, having its fulcrum in the side of the case L, and its short arm within the case, touching the under side of the pin N, its longer or outer arm being graduated and provided with a sliding weight, P.

In the operation, it will be seen, that the steam only exerts a small *annular* lifting pressure, on the under side of the flange G, while the valve, when raised, presents a *large escape area*, offering a *quick relief* for the egress of the steam, which blows off, not only round the flange G, but also up the bore or interior space of the tubular valve F; thus, whatever be the size of the boiler, a *small* weight, J, will suffice, which will render the valve less liable to "stick" or cut a hold, through one-sided pressure on its spindle, caused by jerk or deviation from the perpendicular. The case L and branch M protect the valve from injury or *improper interference*, and thereby aid to constitute a "looked" valve, of which

J is the *maximum* weight that the valve should carry, but through means of the lifting and regulating lever O, it is made *controllable* to a *limited* extent; thus it becomes the "engineer's valve," which, in being *frequently* worked, obviates the liability to "stick," through *corrosion*; combining every advantage of a "looked" valve without its attendant evils, and affording every facility for regulating the pressure, but not admitting of the valve being *overloaded*; for, though by sliding the weight P, on the long arm of the lever O, the weight on the valve will be varied, it never can add to, but only *takes off* from the *maximum* weight J, on the valve; the short arm of the lever O pressing on the under side of the pin N, serving merely to *lift* the valve, but can throw no strain or force (however worked) to close it: so that, by this arrangement, the valve is *governable* to a *safe* extent only. However large the boiler, the valve may be worked *quickly*, and with *small* manual exertion. By requiring but a small force to lift it, a float in the interior of the boiler may be brought to bear upon, and raise it, should the water by any accident have become dangerously low, or any liability of the valve to "stick," is thereby rendered less probable, as any accidental or occasional jerk through the motion of the engine, or machinery, or other tremulous action, will be sufficient to loosen it; but from its peculiar formation, "sticking," or failing to act, is less liable, while *large* relief is

given for the escape of the steam. The ordinary valve, however, may be used, if preferred, in connection with the lifting and regulating arrangement as described.

Yours, ALF'D GREGORY.

NEW-YORK, January 16, 1851.

CARRETT'S PUMP-VALVE.

Fig. 1.

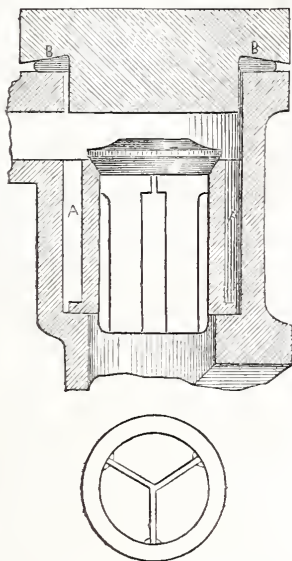
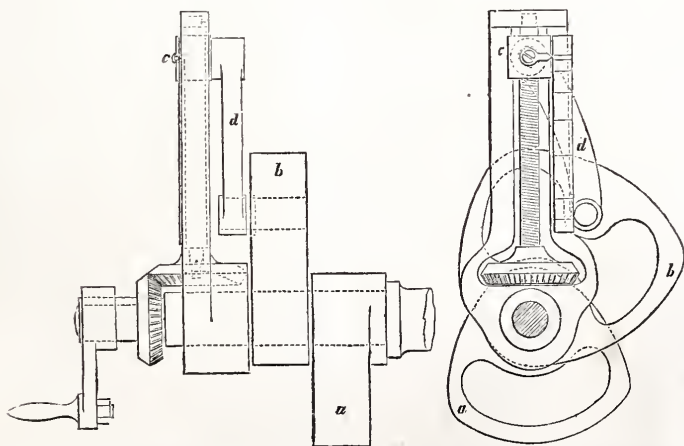


FIG. 1 exhibits a vertical section of a valve, which Mr. Carrett, of Leeds, has introduced in his new steam-pump; and fig. 2 is a plan of the valve. This valve has a clear thoroughfare, the tail pin being only $\frac{1}{8}$ th inch thick in mid section, and the extra width required for guiding the valve in its seat is cut away where the water enters and departs, so that it offers no interruption to the discharge. It is, however, in the mode of placing the valve in its seat that its "economical" value more essentially consists. The valve-chest is not bored, nor is the seat turned outside, but is simply dropped into its place, and rammed round with cement, as at A. The valve and seat may thus be made of gun-metal, at the least possible cost; and their removal is easily effected, without impairing or removing the pump. For water, the joint of the cover is made with vulcanized India-rubber, as at B. Neither cover nor seat require turning, the elastic ring being pressed in such a manner that the greater the force of the water from within, the tighter the joint becomes. The plan presents a very considerable saving in the fitting up of pumps, inasmuch as by it, a rough casting is made as serviceable as one which has been turned and bored out. The valve is now being extensively introduced into locomotives, by Messrs. Wilson of Leeds.

METHOD OF SHIFTING EXPANSION CAMS.



In the use of cams, in various forms of expansion gear, they have to be shifted

round upon their centre to cut off the steam, sooner or later; and this motion

cannot always be obtained without complex gear. One of the most elegant arrangements for this purpose is that of M. Tresel, a French engineer. It will be readily understood, from the sketch below, which represents a side and end view of two cams, *a* and *b*: *a*, being for the ordinary slide, is immovable on the shaft; *b*, which works the expansion slide, is loose on the shaft. On the end of the shaft is a handle attached to a bevel wheel, by turning which the screw turns in the nut, *c*, which it raises or depresses as the handle is turned to the right or left. The nut, *c*, is attached to the link, *d*, which connects it with the cam, *b*; and the frame which carries the screw and nut, *c*, being fixed on the shaft, the motion of the nut turns the cam, *b*, round on the shaft, as required.



INVESTIGATION OF THE PERFORMANCES OF
H. B. M. SCREW STEAM FRIGATE "ARRO-
GANT" AND OF COLLINS' TRANSATLANTIC
PADDLE WHEEL MAIL STEAMER "PACI-
FIC."—COMPARISON OF THE ECONOMICAL
RESULTS AND DETERMINATION OF THE
FRICTION OF THE SCREW OF THE "AR-
ROGANT."

For Appletons' Mechanics' Magazine and Engineers' Journal.

The screw steam frigate "Arrogant," belonging to H. B. M. Navy, was constructed at Portsmouth in 1848, after a great variety of experiments upon the screw had been made by the British Admiralty for the purpose of determining its best proportions. The screw of the "Arrogant" may, therefore, be considered as perfect an adaptation to the vessel as can be obtained with our present knowledge on that subject; and a comparison of it with the common paddle wheel, showing their relative economy as propellers, will be useful in this country where the number of screw steamships is rapidly increasing.

The "Arrogant" mounts 50 guns, 30 of them throwing 60 lbs., and the remainder throwing 32 lbs. shot. The only peculiarity of the hull is the projection or overhanging of the stern, which has an oblong opening directly over the screw, so that it can be hoisted to, or lowered from the deck at pleasure. When the screw is hoisted out of water the "Arrogant" becomes a sailing vessel with-

out drag or hindrance from her propeller. The mechanism by which this emersion of the screw is effected is very simple and was proposed in 1841 (I quote the date from memory), by the French commandant, Henry Labrousse, in a printed memoir to the Minister of Marine, and is as follows: The stern has two sternposts, between which is placed a square frame (fore and aft), containing the screw. At the water-line the deck extends to the after sternpost as does also the side-planking. Through the opening in this overhanging stern, the frame and screw are raised and lowered vertically by worms, working in a rack, secured to the frame. There is a square eye in the screw to receive the engine shaft which is thrust out or drawn in through the stern-bearing, so as to connect or disconnect the engine and screw at pleasure.

The principal features of the screw are: 1st, It is a true helicoid; that is, every portion of it has the same pitch. 2nd, It is composed of *two* blades only. 3rd, The fraction of pitch employed is $\frac{1}{3}$, that is, the surface of the screw is one-third of a single convolution of the thread:—if viewed in projection on a plane at right angles to its axis, one-third the circle would be filled by the screw, each blade filling one-sixth. The screw is $15\frac{1}{2}$ feet in diameter and $15\frac{1}{2}$ feet pitch. Its length on the shaft is $2,583\frac{1}{2}$ feet. The size of the opening through the stern need not then be larger than 8 feet athwart ships by $4\frac{1}{2}$ feet fore and aft, for this first class frigate.

The engines are of the variety known as Penn's double "Trunk" engine.—They are condensing and attached directly to the crank, making turn for turn with the screw. Their ordinary working speed is 60 revolutions per minute. They lie horizontally athwartship, the trunk, 2 feet in diameter, protruding through both ends of the cylinder, and the air pump, which is double acting, is worked from the piston of the steam cylinder; a lighter, more compact or simple combination has yet to be conceived. The total weight of engines, boilers, coal bunkers, &c., is only 142 tons. The weight of water in the boilers is 40 tons more, to which add 260 tons of coal carried in the bunkers, and the aggregate weight of machinery and fuel amounts to but 442 tons. The mean consumption of fuel per 24 hours is 31

tons; the bunkers consequently store coal enough for nearly eight and a half days' steaming. The displacement of the *Arrogant* is about 3,200 tons, the aggregate weight of machinery and fuel is, therefore, but a little more than $\frac{1}{4}$ th. The following are the additional dimensions of the hull that require to be mentioned, viz.: length between perpendiculars, 200 feet. Beam on deck, extreme, $45\frac{3}{4}$ feet. Mean draught of water, $18\frac{1}{2}$ feet. Area of immersed amidship section, 672 square feet.

The mean speed of the vessel in ordinary weather, at sea, under steam and sails, is 9.2 statute miles. Pressure of steam above atmosphere, in boiler, 6 lbs., cutting off at $\frac{3}{4}$ th stroke. Vacuum in condensor, $27\frac{1}{2}$ inches of mercury. Double strokes of engine, 60 per minute. True horses power developed by engine, as obtained from Indicator cards, 672.70. Slip of the screw, 13 per cent. As the slip of the screw, when the vessel is under steam alone, amounts to 24.1 per cent, as will be shown hereafter, the diminution of 11.1 per cent of the slip is due to the sails. As the speed of the screw and vessel are so nearly the same, it might be supposed that the screw was exercising no propelling power: such, however, is far from being the case; the Indicator as well as the Dynamometer show the screw to be exerting its full thrust. The reason for this seeming paradox is to be found in the high resisting power of liquids, when struck under a very acute angle of incidence. The angle of incidence of the screw surface upon the water decreasing with each decrease of slip, and coinciding in the extreme case of no slip, the screw surface experiences with each *decrease* of slip *increased* resistance, which is exactly the reverse of what happens with the paddle-wheel, where *decrease* of slip (caused by the auxiliary action of sails) is accompanied by decreased resistance of the water to the paddles, because the paddles or propelling surface strike the water at right angles to the direction of their movement and not obliquely as in the screw. It follows, as a corollary from these positions, that the screw and sails admit of a perfect combination in the same vessel, neither interfering with the action of the other. The action of the sails in nowise lessening the efficiency of the engines,

which still continue to act at their normal speed and power, however, much the slip of the screw may be reduced. This is in complete accordance with experience which has always given the same results, viz.: that the addition of sail to a paddle-wheel steamer is disadvantageous to the action of the engine and wheels, but highly advantageous under all circumstances when applied to a screw steamer. I could easily elucidate the principle which causes these results, and prove its truth by many well authenticated facts; but the discussion would too much lengthen this paper, and is, beside, foreign to its object; which is to compare, economically, the performance of the screw of the "*Arrogant*" with the paddle-wheel of one of the best and newest paddle-wheel steamers of the same size; and from this comparison to ascertain the value of the friction of the screw surface on the water. The mail steamer "*Pacific*," of Collins' line, happens to have almost the identical dimensions of the "*Arrogant*." Its length between perpendiculars being 210 feet. Beam on deck, 45 feet, and mean draught of water $18\frac{1}{2}$ feet. Its paddle-wheels are 35 feet diameter, and are composed of 36 paddles on each wheel. Length of paddle, $12\frac{1}{2}$ ft., breadth, 28 inches. Mean immersion of lower edge of paddles, 4 feet.

I am, fortunately, in possession of exact data on both these vessels. The "*Arrogant*" was tried at her mean draught under steam alone at a measured mile with the following results, viz.: Speed per hour, 8.35 statute miles. Revolutions of screw and engine, $62\frac{1}{2}$ per minute. Steam pressure above atmosphere, in boiler, 6 lbs., cut off at $\frac{3}{4}$ stroke. Horses power by Indicator, 728.7. The engines consisted of two steam cylinders 60 inches each in diameter, with a central trunk of 24 inches diameter, which being deducted made each cylinder equivalent to one of 55 inches diameter. Stroke, 3 feet.

The mean performance of the "*Pacific*" is as follows, viz. Speed per hour, 12 statute miles. Revolutions of wheels and engine, 13 per minute. Steam pressure above the atmosphere in boiler, 15 lbs., cut off at $\frac{1}{2}$ stroke. Horses power (calculated for an initial pressure in the cylinder 2 lbs. less than in the boiler,

and with a back pressure of 4 lbs. on the piston, making the mean effective pressure on the piston 19.54 lbs. per square inch,) 1964.23. The engines were

of the side lever variety, and consisted of two cylinders 95 inches diameter, and 9 feet stroke. The following will therefore be the

Disposition of power in the "Pacific."

Working Engines	Slip of the centre of reaction of the paddles, . . .	22.9	per cent	or	449.81	true horses.
	Oblique action of the paddles calculated as the squares of the sines under which they strike the water, . .	11.2	"	"	219.99	" "
	Friction of the moving parts of the engine <i>per se</i> , . .	20.6	"	"	404.63	" "
	from experiment 5.5 per cent. Power required to work the air pumps, from experiment, 1 lb. on the steam piston, 5.0 per cent,					
	Friction of the load upon the working journals, from experiment, 10 per cent.					
	Leaving to be utilized in propelling the hull of the vessel	45.3	"	"	889.80	" "
Totals		100.0	"	"	1964.23	" "

Knowing now the power requisite to propel the hull of the "Pacific" at its speed of 12 miles per hour, and considering the hull of the "Arrogant" as identical, the power required to propel it at its speed of 8.35 miles can be easily ascertained. The power being as the

cubes of the speeds, we have $12.00^3 : 889.80 \text{ horses} :: 8.35^3 : 299.78 \text{ horses}$. And 299.78 is 41.14 per cent of 728.7. Hence 41.14 per cent. of the power was utilized in the "Arrogant." We can now ascertain the

Disposition of power in the "Arrogant."

Working Engines &c	Slip of the screw	24.10	per cent.	or	176.62	true horses
	Friction of the moving parts of the engine, <i>per se</i> , from experiment, 5.5 per cent.	23.00	"	"	167.60	" "
	Power required to work the air pumps, from experiment, 1 lb. on the steam piston, 7.5 per cent.					
	Friction of load upon the working journals, from experiment, 10 per cent.					
	Utilized in propelling hull of vessel, ...	41.14	"	"	299.78	" "
	Leaving to be absorbed in the friction of the screw surface on the water, ...	11.76	"	"	85.70	" "
Totals, ...		100.00	"	"	728.70	" "

To ascertain now the relative economical performance of the two systems of propulsion as applied to the above ves-

sels, we will compare their total powers with the cubes of their speeds as the measure of the effects.

	Powers.	Effects.
"Pacific,"	1964.23 or 2.695	12.00^3 or 2.968.
"Arrogant,"	728.70 or 1.000	8.35^3 or 1.000.

And $\frac{2.968}{2.695} = 1.101$. That is the application of the power was *better* in the "Pacific" than in the "Arrogant" in the proportion of 1.101 to 1.000.

Again, by making this comparison in another manner, viz., by the per cents of the total powers utilized in propelling the vessels, we have for the "Pacific" 45.3 per

cent., for the "Arrogant" 41.14 per cent. and $\frac{45.30}{41.14} = 1.101$, or precisely the same as before. Hence we are warranted in concluding, that not only the data is correct, as far as concerns the powers developed by the engines, speeds of vessels and identity of hulls; but that the "*dispositions of power*" are also correct.

The above, however, is a comparison of the performances under steam *alone*. If the comparison be made by the per-

formances under steam *and* sail, the following will be the result.

	Powers.	Effects.
"Pacific,"	1964.23 or 2.920	12.00 ³ or 2.219.
"Arrogant,"	672.70 or 1.000	9.20 ³ or 1.000.

And $\frac{2.219}{2.920} = 0.760$. That is, that the application of the power was *worse* in the "Pacific" than in the "Arrogant" in the proportion of 0.760 to 1.000.

Now, as sail can be used at sea for about $\frac{3}{4}$ the time without deflecting from the course, it follows necessarily, that in practical steam ocean navigation, the screw is the most economical system of propulsion for

"Arrogant."	"Pacific."
$1 \times 1.000 = 1.000$	$1 \times 1.101 = 1.101$
$3 \times 1.000 = 3.000$	$3 \times 0.760 = 2.280$
4.000	3.381

And $\frac{3.381}{4.000} = 0.845$. That is, supposing the wind to blow moderately three-fourths the time, and in such directions that the vessel could keep her course, the application of power with the "Pacific" would be *worse* than in the "Arrogant" in the proportion of 0.845 to 1.000. As the action of the screw is not affected by the pitching or careening of the vessel, the amount of canvas carried need only be limited by the stability of the ship.

We will now return to the investigation of the friction exercised by the screw surface on the water. We have already seen that this friction amounted to 11.76 per cent. of the total power, or to 85.70 horses; but, in order to make this valuation applicable to other screws, it must be reduced to some unit of weight acting with a given speed on a given area of surface. From numerous experiments, it appears that the friction of solids on liquids is as the squares of the velocities and as the surfaces. Assuming this hypothesis to be correct, and taking a speed of 10 feet per second for the unit of velocity, and an area of 1 square foot for the unit of surface, we will deduce from the screw of the "Arrogant" the friction in pounds avoirdupois, on one square foot of the screw surface, moving with a velocity of 10 feet per second.

Now every helix of a helicoidal surface,

from axis to periphery, moves with a different velocity, the helices increasing in length and moving through their lengths per revolution of the screw; it therefore follows that the different surfaces of the helicoid of the same area will exercise different frictions in the proportion of the squares of the velocities at which they move. It is then necessary to ascertain the velocities and areas of these surfaces. This is easily done by the geometrical analysis, which, though not giving strictly accurate results, give an approximation sufficiently close for all practical purposes. By this method the surface of the screw, projected on a line at right angles to axis, is divided into any given number of concentric rings or *elements*; the greater the number of elements taken the closer will be the approximation of the results to the truth. The length of the central line of each element is taken as the length of the element, which, being multiplied by the breadth of the element, of course gives its area. The same lengths of elements, being multiplied by the number of revolutions made by the screw per minute, will give the speed of the elements per minute.

The development of a helix upon a plane is the hypotenuse of a right angled triangle, whose base is the circumference normal to the distance of the helix from the axis considered as a radius, and whose height is formed by the pitch. The distance of any helix (situated on the central line of any element) from the axis, being the distance from the centre of the screw radially to the centre of that element, is known from the diameter of the screw and the number of rings or *elements* into which it may be divided; and the height, which is the pitch, being given; we have the two sides of a right angled triangle given to ascertain the third side, which will be the length of the element. We have now the data for calculating the areas and velocities of the different elements. Supposing the frictions of a square foot of the surface of the screw moving at the velocity of 10 feet

Calculations on the Screw of the "Arrogant."

Pitch $15\frac{1}{2}$ feet; Diameter $15\frac{1}{2}$ feet; Revolutions per minute $62\frac{1}{2}$; Fractions of pitch used $\frac{1}{3}$; Hub $2\frac{1}{2}$ feet diameter.

Pitch of Elements.	Radii of Elements.	Circumferences, normal to Radii of Elements.	Lengths of Elements for one convolution of the thread.	Lengths of Elements actually used.	Breadths of Elements.	Areas of Elements.	Speeds of Elements, in feet per second.	Speeds of Elements, in feet per minute.	Frictions in pounds avoird. for one side only.
A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
		$\frac{2}{3} \frac{B}{1416} \times$	$\sqrt{(A^2 + C^2)}$	$\frac{D}{3}$		$E \times F$	$\frac{I}{60}$	$D \times 62\frac{1}{2}$	$\frac{H^2}{10^2} \times G \times I \times 0.522$
feet.	feet.	feet.	feet.	feet.	feet.	sq. feet.	feet.	feet.	
15 $\frac{1}{2}$	1.5	9.42	18.14	6.05	0.5	3.025	18.90	1133.75	6396.62
—	2.	12.56	19.95	6.65	—	3.325	20.61	1236.90	9297.57
—	2.5	15.70	22.06	7.35	—	3.675	22.98	1378.75	13991.65
—	3.	18.84	24.40	8.13	—	4.065	25.42	1525.00	20904.19
—	3.5	21.99	26.91	8.97	—	4.485	28.03	1681.87	30949.09
—	4.	25.13	29.52	9.84	—	4.920	30.75	1845.00	44730.52
—	4.5	28.27	32.23	10.74	—	5.370	33.57	2014.37	63636.74
—	5.	31.41	35.03	12.68	—	5.840	36.49	2189.38	88901.42
—	5.5	34.55	37.86	11.62	—	6.310	39.44	2366.25	121196.73
—	6.	37.69	40.76	13.59	—	6.795	42.46	2547.50	162918.30
—	6.5	40.84	43.70	14.57	—	7.285	45.52	2731.25	215204.45
—	7.	43.98	46.63	15.54	—	7.770	48.57	2914.38	278846.73
—	7.5	47.12	49.60	16.53	—	8.265	51.67	3100.00	357097.09
Helicoidal area of screw						136.585		1414071.10	
								2	

mains 13 feet, or $6\frac{1}{2}$ feet on each side of the hub, radially to the periphery, to be divided into concentric rings or elements, dividing it into 13 elements of equal breadth; each will be 0.5 feet and $6.05 \div 0.5 = 3.025$ square feet, the area of the element. The screw makes $62\frac{1}{2}$ revolutions per minute, the element consequently passes through its length (18.14 feet) $62\frac{1}{2}$ times in that period, and $18.14 \div 62\frac{1}{2} = 1133.75$ feet per minute or 18.90 feet per second. Now, as the frictions are as the squares of the velocities and the surfaces, and as we have ascertained the friction on one square foot of surface moving at a velocity of 10 feet per second to be 0.522 lbs., the friction on a square foot moving at the velocity of 18.90 feet per second will be

$$10^2 : 0.522 :: 18.9^2 : 1.865.$$

But the area of the element is 3.025 square feet; 1.865 then must be multiplied by 3.025, and the product is 5.626. It is convenient, however, to express the frictions in horses power of 33,000 lbs. moved 1 foot per minute; 5.642 then, must be multiplied by the speed at which it moves per minute—viz., 1133.75, and the product, 6396.62, divided by 33,000 will express the friction of the element in horses power. It is more convenient, however, to postpone this last division until the frictions of all the elements are calculated, and then divide their sum by it.

We have now, however, calculated the frictions for one side only of the element; the opposite side of the blade being identical, the friction for one side has only to be doubled to obtain the total friction.

It may be imagined that the friction on the propelling side of the blades would be greater than on the opposite side, by reason of the greater pressure or thrust. Should this be the case, however, it is obvious that whatever might be the increased friction on the propelling side, owing to this cause, the friction on the opposite side for the same reason, would be decreased by an equal amount; the total friction remaining the same as though the pressure exercised no influence.

It will be seen from the above table that the friction of a square foot of the helicoidal surface of the screw, moving with a velocity of 10 feet per second is 0.522 lbs. avoirdupois, and as this corresponds almost exactly with the mean of a number of calculations, on the fric-

tion of different screws, made in a similar manner, I feel warranted in concluding it to be very near the truth. The total friction once known in horses power, the friction in pounds of a square foot of surface moving with a speed of 10 feet per second, is easily ascertained by

Friction in horses power.

$$2 \left(\frac{H^2}{10^2} \times G \right)$$

33000

B. F. ISHERWOOD,
Chief Eng., U. S. Navy.

TRACTS ON BRIDGE BUILDING.—NO. I.

For Appletons' Mechanics' Magazine and Engineers' Journal.

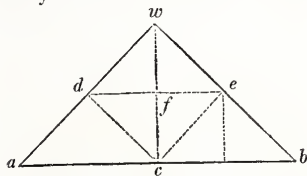
In most elementary works on bridge building with which we are acquainted, the reader is supposed to be versed in the higher branches of mathematics; and, it is in truth desirable that the projectors of important structures of this kind, should be able to bring to their aid all the benefits to be derived from an intimate acquaintance with the higher mathematics; analytic geometry, and the calculus; but in our country it is rarely that men of extensive theoretical attainments are called upon for this purpose, and the duty is, for the most part, confided to the "practical man," so called; who, in most instances, despises what he knows not the value of, and, in consequence, is very generally profoundly ignorant of the A, B, C of his business.

We purpose in these tracts to exhibit, in the first place, the theory of the truss and truss bridges, which is the basis of all framing; and however an expert workman may be enabled to build well and yet in seeming ignorance of this theory, yet it is utterly impossible to design economically without an intimate knowledge of its principles—and this is equally true of all descriptions of framing.

Our aim is the improvement of the young builder and mechanic; and the example of bridges chosen for illustration, including the preparation of foundations and preliminary works, will be selected from the writer's own experience.

It is not too much to expect in this age, that the builder shall be passably conversant with the principles of geometry and the use of algebraic signs and

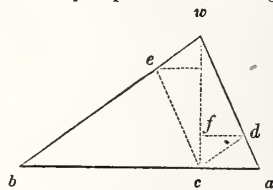
symbols. If he be not, let him devote a short time to the elements of algebra and geometry. It is a great mistake to suppose that the practical man does not need these aids; he is supposed to enter into *some* calculation, for without such his operations will be little better than guess-work; and these methods serve but to simplify, shorten, and generalize such calculations; and he may rest assured, that no man ever rose to eminence as a designer in any branch of the mechanic arts, who was ignorant of the principles of geometry. Brindley, who was profoundly ignorant of letters, was at the same time gifted by nature with a mind to which geometrical truths were as axioms, needing no demonstration to enforce their truth. There are but few Brindleys.



Commencing with the simple truss, let aw, bw be two equal braces connected at the foot by the tie ab , and neglecting its own weight for the present, suppose the truss to sustain a weight W at the point w . Draw wc perpendicular to the tie, and let it represent in magnitude the weight W , that is to say, so many pounds as there are in W ; let there be inches or half-inches or any convenient unit of measure in wc . Draw cd, ce , respectively parallel to wb and aw ; now by the composition and resolution of forces, wc , measured by the same scale as wc , will represent the thrust in the direction of wb , caused by the weight wc or W ; and wd likewise equals in direction and magnitude the strain or thrust in the direction of the brace aw . We suppose the framing to rest at the points a and b on immovable supports; of course, half the weight $\frac{1}{2}W$, will bear on each support, a and b ; and the action at these points will be compounded of a vertical pressure equal to $\frac{1}{2}W$, and a horizontal strain or tension in the direction ab , equivalent to $\frac{1}{2}W \frac{ac}{wc}$. For drawing de , parallel to ab , bisecting wc in f , df represents the tension on the tie ab . For

when three forcers are in equilibrio about a point, if two of them are represented in direction and magnitude by the two sides of a triangle, the third side of this triangle must represent in direction and magnitude the third force. Now the point a is acted upon by three forces: an upward resistance equivalent to $\frac{1}{2}W$, a pressure in the direction wa equal to dw , and the tension of the tie ab which will be the third side of the triangle of which the other two are dw and fw , that is, df ; and in the similar triangles $wdf, wac, dw:fw::aw:cw$; and $df:fw::ac:cw$; or the strain in the direction of a bears the same relation to $\frac{1}{2}W$ that aw bears to cw , and the tension on the tie bears the same relation to $\frac{1}{2}W$ that ac bears to cw , or tension $= \frac{1}{2}W \frac{ac}{cw}$.

On the supposition that the braces are of different lengths, or the weight not immediately over the centre of the tie ab , we should still have the respective strains determined in the same manner. Thus wc representing the weight w , sustained by the braces aw and bw . Completing the parallelogram on this as a diagonal with the direction of the forces for the sides, and drawing df parallel to the tie ab , we have as the result of this arrangement an inequality in the action of the weight on the points a and b . wf represents the weight on



the point a , and fc represents the weight on the point b ; and the side of the triangle wdf , as in the first case, represents all the forces in operation on the point a —viz., wf (the weight on a), which bears the same relation to wc (or the whole weight) that cb bears to the whole tie ab . dw , the strain on the brace aw , and df , the horizontal tension in the direction of the tie ab .

To determine these strains in terms of the given dimensions, as in the first example, we have (taking for convenience of calculation ac as some multiple of ab , say $\frac{1}{4}$) by similar triangles, $d w$:

$f w : a w : c w$, and $d f : f w :: a c : c w$; or the strain in the direction of $a w$, bears the same relation to $\frac{3}{4} w$ that $a w$

bears to $c w$; or $d w = \frac{3}{4} W \frac{a w}{c w}$ and

$d f = \frac{3}{4} W \frac{a c}{c w}$ or the strain on any brace, will be as the length of the brace, divided

by its height, and the tensions on the tie will be inversely as the height of the braces.

The first expression, of the strain on the brace, is the cosecant of the angle of inclination of the brace; and the tension on the tie is the cotangent of the same angle.

SINGULAR EFFECT OF BLOWS ON IRON SHELLS.

Fig. 1.

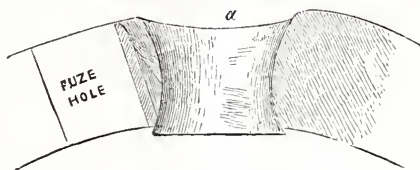


Fig. 2.

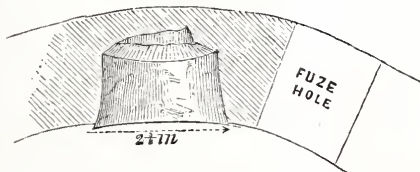
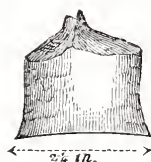


Fig. 3.



SIR,—The shells which form the subject of the following remarks were fired from her Majesty's ship *Excellent*, in Portsmouth harbor, and the fragments afterwards recovered from the mud by men who help out their living by searching for the shot and shells discharged from that vessel. The diameter of the shells in question is 8 in., and they have been burst by the charge of powder in them.

Fig. 1, represents a fragment of the shell, that appears to have received the severest blow, and, by the shape of the indentation upon it, it would appear to have struck upon another shell, or shot, or other round body. In the centre of the hollow, a , a portion of the metal has been completely separated from the rest of the shell, and assumed the form of a bolt, or rivet, and has the appearance of having been riveted at each end; but the perfect smoothness on the inside, and the impossibility of performing such an operation, shows that it could not have arisen from any other cause than the concussion on striking the object with which it

came in contact, after it was discharged from the gun.

The effect on another shell, delineated in fig. 2, shows that the formation of these bolts arises entirely from the blow received on striking a hard substance after the discharge, and not from any peculiarity in the manufacture of the shell; for in this instance the blow did not form a complete bolt, or rivet, but only a partial one, commencing from the inner surface. Fig. 3 is another view of the bolt in fig. 2, which is not quite circular, but rather oval, as will be seen by the dimensions given. The diameter of the perfectly-formed bolt (fig. 1) at the centre is exactly the thickness of the metal of the shell, and that of the incomplete bolt is rather more.—J. J. LAKE: *Portsmouth, June 13.*

MECHANICS FOR THE MILLION.—NO. I.
For Appletons' *Mechanics' Magazine and Engineers' Journal.*

The compiler of this series of papers acknowledges his indebtedness for the ar-

rangement, to several works of Mr. Tate and others on mechanics; but to Mr. Tate in particular he is indebted for the simple and practical method of investigating the values of work.

Preliminary ideas on Work.—In order to have work performed, we must have not only pressure, but that pressure must be sustained through a certain space; or, in other words, the idea of motion is essential to work. Hence, when a man carries a weight up a ladder or staircase, we say that he does work; but if he stood still with his load, then, although he would sustain the same pressure, yet he would not do any work. If two men were to carry the same weight of material to the same height, then they would do the same work; and if the one were to carry one-half the weight to four times the height, then he would do twice the useful work of the other.

As we measure distance by the number of times that some unit of length, such as a foot or yard, is contained in the proposed distance, so the measure of work must be some unit of work.

Unit of Work.—A proper unit of work is the labor requisite to raise one pound through the space of one foot. Thus, if a man take a pound weight in his hand and raise it one foot, he will perform one unit of work; if he raise it two feet, he will perform two units of work; and if he raise it three feet, he will perform three units, and so on. If he take a four pounds weight in his hand, and raise it five feet, he will perform twenty units of work, because in raising one pound five feet, he will perform five units; therefore in raising four pounds the same height, he will perform four times five units, or twenty units. Here then we observe, that in order to obtain the work expended in raising any body, we multiply the weight of the body in lbs. by the vertical space in feet through which it is raised.

As resistances and pressures of every kind may be expressed in pounds, it follows that the unit of work here laid down will measure every kind of work. It will also afterwards be seen that a unit of work is done whenever one lb. pressure is exerted through a space of one foot, no matter in what direction that space may lie.

Examples.

Ex. 1. Required the units of work ex-

pended in raising a weight of 60 lbs. to the height of 23 feet.

Units of work in raising 1 lb. 23 ft. = 23.
 $\therefore$ " 60 lbs. = 60 times 23 = 1380.

Ex. 2. The ram of a pile engine weighs 7 cwt., and has a fall of 23 feet; it is required to find the work performed in raising the ram.

Weight of the ram in lbs. = 7×112
 = 784 lbs.

Units of work in raising 1 lb. 23 ft. = 23.
 $\therefore$ " 784 lbs. " = 784 times 23 = 18032.

Ex. 3. How many units of work would be required to raise 4 cwt. of coal from a pit whose depth is 70 fathoms?

Weight of coal in lbs. = $4 \times 112 = 448$ lbs.
 Depth of the pit in feet = $70 \times 6 = 420$ ft.
 Work in raising 1 lb. 420 ft. = 420.
 $\therefore$ " 448 lbs. " = 448 times 420 = 188160.

Ex. 4. If the weight of a man be 140 lbs., and if he ascend the perpendicular height of 50 feet, how many units of work would he perform?

Here the weight raised is in the man's body = 140 lbs.
 $\therefore$ Work = $140 \times 50 = 7000$.

If the man were then to descend by a basket, it is evident that he would perform the same work upon a counterpoise weight, which he had done in ascending.

Ex. 5. How much work would be required to pump 3000 cubic feet of water from a mine whose depth is 160 fathoms? Here the weight of a cubic foot of water is 62.5 lbs., then,

Weight of water = $62.5 \times 3000 = 187500$ lbs.

Depth of the mine in ft. = $160 \times 6 = 960$ feet.

$\therefore$ Work = $187500 \times 960 = 180000000$.

Ex. 6. If a horse draw 104 lbs. out of a well, by means of a cord going over a wheel, moving at the rate of $2\frac{1}{2}$ miles per hour; how many units of work will he perform per minute?

Space moved over per min. = $\frac{2\frac{1}{2} \times 5280}{60}$
 = 220 ft.

$\therefore$ Work per min. = $220 \times 104 = 22880$.

When considerable distances are measured, we may use a higher unit than that of feet or yards; so, in like manner, when the work is very great, it is found more

convenient to adopt a larger unit of work. Watt estimated that a horse could perform 33000 units of work per minute; that is to say, he can raise 33000 lbs. one foot high per minute; this work therefore is called a horse power. It will now be easy to express work done in a given time, in units of a horse power, and conversely.

Ex. 1. How many horse powers would it take to raise 1 cwt. of coal per minute from a pit whose depth is 200 fathoms?

Weight of coal in lbs. = 112 lbs.

Depth of pit in ft. = $200 \times 6 = 1200$ ft.

As 112 lbs. of coal are raised every min.

$\therefore$ Work done per min. = $112 \times 1200 = 134400$.

Now a horse does 33000 units of work in this time, therefore as many times as we can take 33000 out of 134400, so many horse powers must we have, that is,

Horse powers, or H.P. = $\frac{134400}{33000} = 4.07$.

Ex. 2. How many H. P. would be required to raise 2000 cubic feet of water per hour, from a mine whose depth is 180 fathoms?

Weight of water in lbs. = 62.5×2000 .

Depth of the mine in ft. = 180×6 .

$\therefore$ Work per min.

$$= \frac{62.5 \times 2000 \times 180 \times 6}{60}$$

And H. P.

$$= \frac{62.5 \times 2000 \times 180 \times 6}{60 \times 33000} = 68.1.$$

Ex. 3. A Winding Engine is moved by two horses; what weight of coal will be raised per hour from a pit whose depth is 50 fathoms?

Work done by the horses per hour = $33000 \times 2 \times 60 = 3960000$.

Depth of the pit = 300 feet.

Work in raising 1 lb. of coals = 300.

Now as 300 units of work go to raise 1 lb. of coals, therefore as many times as 300 can be taken out of 3960000, so many lbs. must be raised in the given time.

$\therefore$ Number lbs. raised per hour

$$= \frac{3960000}{300} = 13200 \text{ lbs. or } 5.9 \text{ tons.}$$

Ex. 4. In what time will an engine, capable of performing the work of 8 horses, raise a ton of material from the depth of 170 fathoms?

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Work of the engine per min. = 33000
 $\times 8 = 264000$.

Work in raising 1 ton = $2240 \times 170 \times 6 = 2284800$.

Here, as the engine does 264000 units of work every minute, therefore as many times as we can take this number out of 2284800, so many minutes will be taken in raising one ton; that is,

Number min. to raise 1 ton

$$= \frac{2284800}{264000} = 8.6 \text{ min.}$$

Ex. 5. How many cubic feet of water will an engine of 20 horse powers raise per hour from a mine whose depth is 80 fathoms?

Work done per hour = $33000 \times 20 \times 60$.

Work in raising 1 foot of water = $62.5 \times 80 \times 6$.

$\therefore$ Number ft. raised per hour

$$= \frac{33000 \times 20 \times 60}{62.5 \times 80 \times 6} = 1320.$$

Ex. 6. From what depth will an engine of 5 horse powers raise 4 tons of coals per hour?

Work done per hour = $33000 \times 5 \times 60$.

Work in raising 4 tons of coals 1 ft. = $2240 \times 4 \times 1$.

$\therefore$ Number feet in depth

$$= \frac{33000 \times 5 \times 60}{2240 \times 4} = 1104 \text{ ft.}$$

Ex. 7. An engine is observed to raise 3 tons of material per hour from a mine whose depth is 120 fathoms; it is required to find the horse powers of the engine, supposing $\frac{1}{5}$ of its work to be lost in transmission.

Work done per min.

$$= \frac{2240 \times 3 \times 120 \times 6}{60} = 80640.$$

Now only $\frac{4}{5}$ of the work of the engine go to raise the material.

$\therefore$ Useful work of one H. P. per min. = $\frac{4}{5} \times 33000$.

$$\text{And H. P.} = \frac{80640}{\frac{4}{5} \times 33000} = 3.05.$$

Ex. 8. What must be the horse powers of an engine working for 10 hours per day, to supply 3000 families with 80 gallons of water each per day, supposing the water to be raised to the mean height of 70 feet?

A gallon of water weighs 10 lbs.

∴ The water pumped per minute

$$= \frac{3000 \times 80}{10 \times 60} = 400 \text{ gals.}$$

∴ Weight of water pumped per min.

$$= 400 \times 10 = 4000 \text{ lbs.}$$

$$H. P. = \frac{4000 \times 70}{33000} = 8.4.$$

Ex. 9. Required the horse powers of an engine which pumps water from three different levels, whose depths are 40, 70, and 90 fathoms respectively; from the first 20 cubic feet of water are raised per minute, from the second 10 feet, and from the third 35 feet.

Work per min. in the

$$1\text{st level} = 62.5 \times 20 \times 40 \times 6.$$

$$2\text{d} \quad " = 62.5 \times 10 \times 70 \times 6.$$

$$3\text{d} \quad " = 62.5 \times 35 \times 90 \times 6.$$

$$\therefore \text{Total work per min.} = (20 \times 40 + 10 \times 70 + 35 \times 90) 62.5 \times 6.$$

$$\therefore H. = \frac{4650 \times 62.5 \times 6}{330000} = 52.8.$$

Ex. 10. There were 4000 cubic feet of water in a mine whose depth is 60 fathoms, when an engine of 70 horse power began to work the pump; now the engine continued to work for 5 hours before the mine was cleared of the water; required the number of feet of water which had run into the mine per hour, supposing $\frac{1}{8}$ of the work of the engine to be lost in transmission.

$$\text{Effective work of the engine in 5 h.} = 33000 \times 70 \div 60 \times 5 \times \frac{7}{8}.$$

$$\text{Work in raising 1 ft. of water} = 62.5 \times 60 \times 6.$$

Number feet of water pumped

$$= \frac{33000 \times 70 \times 60 \times 5 \times 7}{62.5 \times 60 \times 6 \times 8} = 20533.$$

$$\therefore \text{Water run in during 5 h.} = 20533 - 4000 = 16533 \text{ ft.}$$

$$\text{Water run in during 1 h.} = \frac{16533}{5} = 3306 \text{ ft.}$$

Ex. 11. A forge hammer weighing 2 cwts. makes 60 lifts per minute; now the perpendicular height of each lift is $2\frac{1}{2}$ feet; it is required to find the horse powers of the engine giving motion to the hammer.

$$\text{Weight of hammer in lbs.} = 112 \times 2 = 224 \text{ lbs.}$$

$$\text{Work in each lift} = 224 \times 2\frac{1}{2} = 560.$$

$$\text{Work in 60 lifts, or per min.} = 560 \times 60 = 33600.$$

$$\therefore H. P. = \frac{33600}{33000} = 1.02 \text{ nearly.}$$

Ex. 12. An engine of 5 horse powers raises 30 cwts. of coals per hour from a pit whose depth is 240 fathoms, and at the same time gives motion to a forge hammer which makes 25 lifts per minute, each lift being 3 feet; it is required to determine the weight of the hammer.

$$\text{Work done by the engine per min.} = 33000 \times 5 = 165000.$$

$$\text{Work in raising coals per minute} = \frac{30 \times 112 \times 240 \times 6}{60} = 80640.$$

$$\therefore \text{Work in raising hammer per min.} = 165000 - 80640 = 84360.$$

$$\text{Work per min. in raising 1 cwt. of the hammer} = 112 \times 3 \times 25 = 8400.$$

$$\therefore \text{Number of cwts. in the hammer} = \frac{84360}{8400} = 10 \text{ cwts.}$$

PAINE'S HYDRO-ELECTRIC LIGHT.

We should not have noticed this alleged discovery, but so much has been said and written upon it, both at home and abroad, that our journal would appear incomplete this month without some allusion to it.

Several statements have appeared as published by gentlemen whose veracity is unquestioned, and who have witnessed the experiment made by Mr. P.; but none of these gentlemen have been able to repeat them with success in their own laboratories, although eminently qualified for the undertaking, and having had the benefit of Mr. P.'s instruction, so far as explaining his machine, besides witnessing the *modus operandi*. From some of these statements we compile the following description of the machine used, and the results.

First: A common Magneto-Electric Machine, M M, consisting of two permanent horseshoe magnets about *twelve inches* long. These were placed horizontally on a mahogany frame, about *four inches* apart, one being placed above the other. Between the ends of these magnets were a pair of *helices*, H, and these so attached to a wheel above, that they could be set into a rapid rotary motion. This machine differs from the ordinary one only in the composition of the helices, which, instead of being solid wire, are hollow

copper tubes about $\frac{1}{8}$ inch in diameter and filled with water.

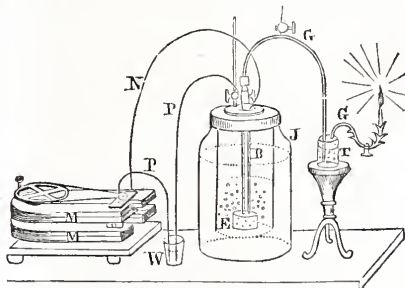
Second: A large open-mouth glass jar, J, capable of holding twelve quarts. This was a little more than half filled with water. Within this jar was placed a common bell-glass, B, open at the bottom, and reaching within four inches of the bottom of the large jar. The top of the bell-glass was closed tightly with a brass cap, which extended over it, so as to rest upon the sides of the outer jar. Passing through the cap of the bell-glass, were two wires, which extended down nearly to the bottom of the bell-glass, and these terminated in a circular metallic box, E, one and a half inches long, and one inch in diameter. This box was hollow, and perforated with small holes in the upper part. The *electrodes* or points of connection between the poles, were in this box, and are made of platinum; they presenting to each other a very large amount of surface, and angles in close proximity. This is effected by having one electrode constructed like a honey-comb, and the other with short wires or pins, which dip into the cells of the said honey-comb. The two electrodes are inclosed in a metallic case in the water, with holes for the escape of gas. These electrodes we believe are not shown, but described by Mr. P. to the visitors. The water in the jar and bell-glass, reached some six inches above the electrodes.

Third: A quart glass jar, T, half filled with spirits of turpentine. A tube or gas-pipe passed from the top of the bell-glass (above mentioned), and into this jar of turpentine, terminating at the bottom of the turpentine. From the cap which covered the jar of turpentine, another tube or gas-pipe passed to a jet or burner, about twelve inches from the jar.

Fourth: A common glass tumbler, W, half filled with water.

The above comprised all the apparatus used by Mr. Paine, with the exception of three wires or rather flat strips of copper, by which he connected the Magneto-Electric Machine with a jar of water. These wires were connected in the following manner: The end of one wire was screwed to the *negative* pole of the magnetic machine marked N; and the other end, to the first of the wires coming up from the *electrodes* through the top of the bell-glass. A second wire was screwed

to the *positive* pole of the magnetic machine marked P, with the other end terminating in the glass of water above mentioned. The third wire was screwed to the second wire which passes from the electrodes within, and terminating in the same glass of water, although the wires in the glass did not touch each other. They were not wires, but merely thin strips of copper, having the appearance of being rolled out from wire.



M. M. Permanent Magnets. B. Bell-Glass.
H. Revolving Helix. E. Electrodes.
N. Negative Wire. T. Jar of Turpentine.
P. P. Positive Wire. W. Tumbler of Water.
J. Jar of Water. G. G. Gas Pipes.

For the operation of the machinery upon turning the wheel in the Magneto-Electric Machine, large bubbles of gas arose from the electrodes, and *filled the jar in less than a minute!* After taking out a stopper from the bell-glass, and allowing several jars full of gas to escape, in order to expel the common air, and prevent an explosion, these were stopped, and the gas forced on through the gas-pipe into the turpentine, and through this to the jet or burner. Between the jar of water where the gas was generated, and the jar of turpentine, a jet issued from the pipe. This was lighted, and proved to be hydrogen gas. The flame, in front of a window, was so pale that it could not be perceived. While this was burning, the gas was forced along through the turpentine to the other burner. A flame was applied to this and a *brilliant light was shown!*

Here were two flames, burning at the same time, from the same gas—the first, before passing through the turpentine, burning with a pale, almost imperceptible light—the second, after passing through the turpentine, burning with a light equal to any gas. When the Magnetic Machine was stopped, not a bubble of gas would appear in the jar, and the lights went out.

This small machine generated gas enough to supply a dozen burners, *any one* of which is sufficient to light a room.

One of the visitors, somewhat suspicious, with Mr. P.'s permission examined the table, and says, "I could easily see that no wires or pipes entered the glass jar of turpentine, or the glass jar of water, except the two connected with the magnetic machine. It was therefore to the magnetic machine that my attention was mainly directed. This machine I took up, and lifted entirely away from the table—saw that no wires, pipes or metallic substances whatever had any connection with it from the table. I placed the machine again on the table and turned the crank, and produced the gas in the jar in the same manner and with the same success that Mr. Paine had done." Further,

"The gas produced *appeared* to be hydrogen—we judged by the smell and the burning—and yet, *Mr. Paine said, although he called it hydrogen gas, it differed from the ordinary hydrogen.* I asked Mr. Paine why he interrupted the *positive pole* by the glass of water, why he cut this wire in two and placed the ends in the glass of water? He said that unless this was done, both *hydrogen and oxygen* would be generated in the bell-glass; but that by this means he only obtained the hydrogen. He asserted that if the positive wire is uninterrupted and the negative interrupted in water, the sole product will be oxygen. *And after seeing the hydrogen produced alone, we are prepared to believe that.* There appeared to be no oxygen generated by the operation.

As to the amount of turpentine consumed by passing the gas through it, it was impossible for us to determine in the short time—an hour—we were engaged in generating and burning the gas. Mr. Paine stated that the gas was not carbonized but was *catalized* in passing through the turpentine, and there was no loss to the turpentine by the process. Several gentlemen of high standing in Worcester, a few days previous to our visit, purchased at a store a small quantity of turpentine, measuring it accurately, which they took to Mr. Paine's establishment and passed the gas, produced by three sets of magnets, through it for several hours, lighting the whole of Mr. Paine's house. The turpentine was again measured at the close, and found to have lost only as

much as would be lost by evaporation, and by turning it from one vessel into another. A certificate was published to that effect."

Mr. P. is getting up a machine, composed of three of the sets of magnets, for the World's Fair, the power of which he asserts is "not simply three times that of the single machine, but about twenty-seven times. He supposes that by combining the currents of several magnets, the decomposing power increases as *the cube* of the number of currents. * * * *

Mr. Paine thinks this larger machine will feed a thousand burners. This we are not so sanguine as to believe, but we have no doubt it will light a considerable hotel."

Still further—"a scientific friend of ours, who has made electricity his particular study, has seen the operation of Mr. Paine's smaller apparatus, and is convinced of the reality of the discovery, though he is not so sure of the quantity of the gas generated. He thinks that the evolution of hydrogen in his presence went on about fast enough to support an ordinary bat-wing burner. He acknowledges, however, that the development in his presence was more than sufficient by explosion to have given the motion to the helices, so that a perpetual motive power is secured."

The visitors who examined this machine, and who have here reported upon it, were Mr. Huse, of Boston, Mr. Ames, of Springfield, W. Merriek, President of the Gas Company in Boston; also G. Q. Colton, and the editor of the Boston Commonwealth.

It seems, however, that Mr. Paine has taken a new mode of testing a matter of science.

WORCESTER, Jan. 4th, 1851.

Editor Boston Atlas:—

DEAR SIR,—I have but little time to notice the various newspaper articles on the subject of the hydro-electric light, and much less inclination to prove by argument what I have already shown by demonstration, but I have some inclination to test the honesty and SCIENCE of the writer of the article in your journal of the 2d inst. He says, "It is a fact well known that the battery cannot be brought to act upon a fluid, unless both poles are inserted in it, in such approximation as to complete the circuit and set the electric current in motion." Now I am ready at any time within ten days from the

date of this, to go to Boston and use a battery and electrodes of the writer's selection, and in presence of any persons whom he may select, and I will *without completing a circuit* or passing but *one* current through the water evolve hydrogen gas, and *hydrogen alone*, upon the following condition:—If I fail to accomplish the promised result, I am to place in the hands of the Mayor, or other person chosen, the sum of \$5000, to be given to some charitable institution. But if I do accomplish what I promise, then the like sum is to be in like manner disbursed by your anonymous correspondent.

HENRY M. PAINE.

The challenge has been accepted in the following terms.

Mr. Paine's Challenge Accepted.

MESSRS. EDITORS:—I notice, in the Atlas of Tuesday last, a communication signed by "Henry M. Paine," proposing a stake of \$5000, to be forfeited by him or me, according as he shall fail or succeed in establishing certain particulars relating to his new electric theory, by experimental demonstration. His challenge, he says, is to "test" my "*honesty and science*." Now, whether an individual's *honesty* may be fairly tested by a *gambling* operation is a moral question, which we leave to be decided by the skilful casuist; but as a *scientific* test, we are confident that such a proposition is novel and unprecedented.

But let us glance at the probable *motives* of this challenge. If his object was simply to *convince* the public of the truth and utility of his discovery, this might be accomplished as *well*, and far more *honorably*, by a series of experiments not involving a forfeit or stake. A truly scientific discovery needs no such "backing up;" but to sustain an *imposture*, it is often necessary to resort to this species of *bravado*, which, where a better argument is wanting, may serve to carry conviction to the weak and credulous. But it evidently does not suit Mr. Paine's purpose to sustain his discovery by simple demonstration; therefore he would silence all scientific objections by proposing a *bluff game*—at which I certainly dislike to play; but, as it is manifestly for the interest of all concerned that the *truth* upon this subject should be at once elicited, so that the public may be secured from further imposition, I am ready to accept Mr. Paine's challenge, with a full understanding as to the fair and honorable adjustment of the details of the proposed experiment. I stipulate, according to the terms of his proposition, that the electric circuit is not to be complete—that there shall be no possible connection be-

tween the poles of the battery, either by metallic fluid, or any other electric conductor; also, that there shall be no oxygen generated, in a free or combined state; and, further, that Mr. Paine shall show, to the satisfaction of the supervising committee, that he proposes that but *one* current of electricity passes through the fluid, by the agency of which hydrogen alone is disengaged.

I am thus particular in settling the details, as the peculiar terms in which his proposition is expressed affords an indefinite margin, which might be wrested to the undue advantage of a party disposed to cavil upon technicalities. I shall be pleased to arrange all necessary preliminaries with Mr. P. at his earliest convenience. F.

In deciding upon the practical merits of a new discovery, we are frequently enabled to come to a correct conclusion as to its value, by reasoning from analogy. That is to say, if the method pursued is in accordance with well-established principles, violating no known or presumed laws, and its results such as follow immediately from the observance of these laws, we may at least conclude that the invention is not wholly without merit; particularly if the result sought is to appearance accomplished; but when the invention sets at defiance some of the laws of matter, as determined after years of laborious investigation by men whose research and skill in their particular department is a theme for universal admiration; it is clearly more becoming in us to doubt the truth of the results shown, than by admitting them, to throw distrust upon the sagacity of our *masters*.

If a machine were shown us which, actuated by a weight falling through a certain distance in a given time, lifted a greater or equal weight through a greater or equal distance in the same time, we should be justified at once in condemning it; because we may calculate from known laws what the effect of the weight *should be*, and, in general, in deciding upon the merits of any purely mechanical contrivance, *reasoning* from a few elementary laws will enable us to determine whether the machine is contrary to the true principles of mechanism. But in chemical mechanism, many an hypothesis may be advanced, contrary to the presumed laws of matter, and yet it may be unphilosophical to pronounce the assumption unqualifiedly false—for chemical sci-

ence is based less on reasoning from certain fixed principles, than from an observance of certain facts; and no man can say, let his knowledge of chemistry be what it may, that he has discovered the law by which a certain substance will invariably act upon all others—not that the laws of chemistry are capricious, but that we have not mastered them.

We know for instance, that a few drops of the bichloride of Titanium, a transparent colorless liquid, will, upon the addition of a few drops of water, both being cold, unite with great heat and violence and form a solid; but the fact is of no use to us in deriving a law for the action of water with other substances, however similar they may be in appearance or organization.

Judging of Mr. Paine's light by the lights of chemical science as demonstrated and established by such men as Biot, Arago, Ampère, Davy, Faraday, Liebig—we should say it was a barefaced imposition.

In the first place, he claims to have discovered that by a modification of the ordinary magneto-electric machine, he can *convert the whole of a given quantity of water into either hydrogen, or oxygen gas as he pleases*, according as the positive or negative wire from his battery is severed, the severed ends being in communication by a short interval of water.

Secondly, The evolution of hydrogen gas is increased *indefinitely*, to such an extent, *that a tithe of the gas, if consumed as a fuel, would afford power sufficient to drive many machines.*

Thirdly, The hydrogen is carburetted, or rather *catalized*, by passing it through turpentine; the latter remaining unaltered and undiminished.

And Lastly, He claims to be able to convert the water into hydrogen *without* completing the electric circuit.

Before attempting to test Mr. P.'s alleged discovery by any of the, at present, known laws of matter, it may be well to glance at his own statements from time to time of the nature of his invention; among others of his having declared two years since (as the result of his investigations which he was about making public), his ability to procure by "electrical action from lime and water, and at a cost of 1 mill per burner, a light equal in intensity to 4000 gas burners of

the largest bat-wing pattern" (see last number of this Magazine). One would suppose that this result, which he positively affirms he had arrived at, and which he contemplated making public, would have satisfied most men; but it seems our friend was not satisfied with lighting a town at the enormous expense of 1 cent per night—he must have his light for nothing; nay, not even satisfied with this, his light, besides producing itself, shall at the same time generate a power, which in its turn shall generate another, and so on, *ad infinitum*—and at the cost of water!—for this, and nothing less, is the legitimate result of his new discovery.

Can any one believe that the discoverer of such infinite power would be compelled to offer a *bet* as the readiest way of silencing cavillers? But we are very much mistaken, if this challenged exhibition ever comes off; if, indeed, the whole affair, challenge and acceptance, be not got up for effect by Paine himself;—his previous history rather justifies this suspicion; and a closer examination of his challenge shows, either that he is ignorant of electrical action, or that he intends deception in the experiment, or that he intends to shelter himself behind the vagueness of phraseology in his challenge. He is very likely, if no other loophole offers, to assert, that by the expression "without completing a circuit," he intended to be understood as meaning—a *metallic* circuit.

To talk of decomposing water by electrical action without a connection of some sort between the poles of the battery, is absurd. We will not pretend to say, that Paine may not have stumbled upon some discovery in magnetic-electrical action; for the pretender in this science cannot always be put down, as in purely mechanical matters, by showing a violation of acknowledged principles; but his assertion of a fact, must be disproved experimentally.

Setting aside for the present all other seeming contradictions of known chemical laws, let us examine his claim to having discovered that he can by the same agent convert a given quantity of water either into hydrogen or oxygen; that is, that they are but different electrical states of the same element, or in other words, that water is a

simple substance. Upon the truth of this, we conceive his whole discovery to rest.

Hydrogen gas was discovered by Cavendish in 1766. The combustion of this gas produces water, which he first demonstrated by burning it with oxygen: the latter gas itself being uninflamable, but the known supporter of all combustion; the water generated, equalling exactly in weight the combined weight of the gases. In passing a given weight of water over red-hot iron inclosed in a glass tube, the oxygen unites with the iron and the hydrogen is disengaged: proved by weighing them both; for the iron is increased in weight by the oxygen, and together with the hydrogen weighs precisely as much as the water before decomposition.

Oxygen was discovered by Priestly in 1774. It may be procured by placing in a retort equal quantities in weight of the peroxide of manganese and concentrated sulphuric acid, and subjecting the mixture to heat. It is the most perfect — electric; always appearing at the + electrode,* as hydrogen does at the —, and can be mixed with hydrogen gas in any proportion without combining with it. In order to produce water by their combination, the passage of a current of electricity though the mixture is essential; and let them be mixed in whatever proportions they may, one measure of the oxygen unites with two of the hydrogen, producing water in weight equal to the sum of the weights of the gases consumed. If a greater proportion of hydrogen than that of two to one of the oxygen be present in the mixture before combustion, the surplus of hydrogen will be found remaining in the gaseous state unchanged. In other words, they will unite in but one proportion in forming water, and then only by this combustion. Now if they be but different electrical states of the same substance, why should the passage of the electrical spark through them be essential to their perfect union,—and why should the surplus of hydrogen which refuses to unite with the oxygen have suffered no changes by the operation? We grant that this proof is of a negative character, but it is at least as good as Mr. P.'s assertion; and until he

shows in the case of converting the water entirely into one of the gases what becomes of the other, we shall be justified in believing what has been so well shown years since—that water is compounded of two essentially different substances.

We had proceeded thus far not without many misgivings that "*le jeu n'en vaut pas la chandelle*," when the statement of Mr. P.'s brother appeared in the Tribune, to the effect that the gas obtained by his machine was highly explosive, to the degree of rendering it difficult of use—having blown up some nine times in as many months.

It will scarcely be expected after this, that we shall gravely attempt to prove Mr. P. not one of the lights of the age. Hereafter, and until we see his light, we cannot be censured for disbelieving in its existence.

FORMULA FOR RAILROAD SWITCHES.

To our correspondent in Albany who asks for a simple formula for laying off turnouts, and putting in frogs and switches, we commend the following; prepared we believe by Mr. Post, Engineer on the N. Y. & E. Railroad.

For a Turnout on a straight line.

Put $BC = CF =$ Radius of Curve and represent it by . . . R

$AB = AD =$ Half width between centres of tracks, by . . . a

$EF = EF' =$ Half of straight line between curves, by . . . c

$BG = FG =$ Tangents to curve, by x

$AE = AE =$ Half length of Turnout, by m

Then $CF^2 + EF^2 = CE^2$. and $CE^2 - A'E'^2 = A'E^2$

Or $R^2 + c^2 = CE^2$ and $R^2 + C^2 - (R - a)^2 = m^2$

But $R^2 + c^2 - (R - a)^2 = 2Ra - \frac{a^2 + c^2}{2}$. and $\sqrt{2Ra - \frac{a^2 + c^2}{2}} = m$.

Then $EG^2 - EH^2 = GH^2 = (AE - BG)^2$

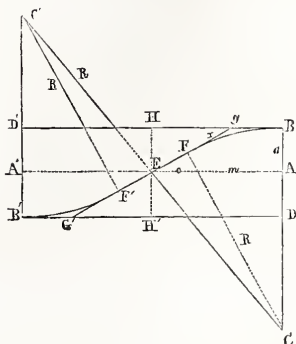
Or $(x + c)^2 - a^2 = (m - x)^2$. i. e. $x^2 + 2cx + c^2 - a^2 = m^2 - 2mx + x^2$, and $2cx + 2mx = m^2 - c^2 + a^2$
 $- c^2 + a^2 \therefore x = \frac{m^2 - c^2 + a^2}{2(c + m)}.$

* *Electrodes* are the surfaces, whether of air, water, or metal, which serve to convey an electrical current into and from the liquid to be decomposed.

By substituting in the above Formula for m^2 its value then

$$x = \frac{2 R a - a^2 + c^2 - c^2 + a^2}{2(c+m)} = \frac{R a}{c+m} = \text{Tangent.}$$

Fig. 1.



Example.

Suppose R the radius given = 800 ft.
 " a " half width = 6.5 "
 " c " half straight line = 8 "

Then $\sqrt{2 R a - a^2 + c^2} =$
 $\sqrt{2 \times 800 \times 6.5 - 6.5 \times 6.5 + 8 \times 8}$
 $= 102.087 = m$ and
 $\frac{R a}{c+m} = \frac{800 \times 6.5}{8 + 102.087} = 47.235 =$
 Tangent $B G = G E$.

To determine the angle.

Tang: $\angle G E A = \frac{\sin.}{\cos.} = \frac{a}{m-x}$ or
 $\frac{6.5}{54.852} = 0.1185 = \text{Nat: Tang: } 6\frac{3}{4}^\circ$.

The Angle just found is for the frog or crossing of the Rail.

Having given the distance the end of the movable rail slides, to determine how far the movable end of the Rail is from the origin of the curve.

Put Fig. 2, $B I = O P =$ the distance from the origin B of the curve to the movable end of rail, and $I P$ the distance the end of the rail is permitted to slide.

$B C =$ radius.

Then $B O : O P :: O P : B C + O C$.

or $\sqrt{B O (B C + O C)} = O P = B I$.

Example.

Suppose the Rail to move $5\frac{1}{2}$ inches, or $\frac{1}{4}$ of a foot, the radius being 800 feet.

Then distance $B I = \sqrt{\frac{11}{24} \times 1599\frac{13}{24}} = 27.076$ feet.

To find the point F by means of the ordinates $M F, N F$.

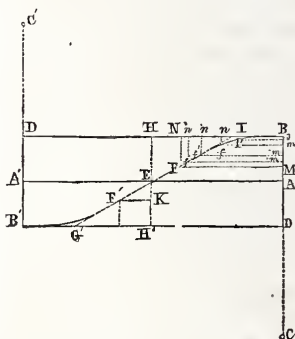
$G' E : G' H' :: F' E : F' K$, and $A E - F' K = M F = B N$, or as shown by previous notation $c + x : m - x :: c : \frac{c(m-x)}{c+x}$, and $m - \frac{c(m-x)}{c+x} =$

$M F = 102.087 - \frac{8(102.087 - 47.235)}{8 + 47.235} = 94.143$.

Then $\sqrt{B C^2 - M F^2} = M C : B C - M C = B M = N F$, or,

$\sqrt{(800 \times 800) - (94.143 \times 94.143)} = 794.441$, and $800 - 794.441 = 5.559 = N F$.

Fig. 2.



In this manner also may any number of intermediate ordinates $n f, n f', n f''$ be calculated: the length of the co-ordinates $m f, m f', m f''$ being assumed and the results arranged in tabular form for use.

Table of Ordinates for Turnout 800' Rad :

At 27.076 ft. from Origin of Curve	0.458	or 5.5 in.
" 30	"	0.503 " 6.75 "
" 40	"	1.000 " 1 "
" 50	"	1.564 " 1.6 "
" 60	"	2.253 " 2.3 "
" 70	"	3.069 " 3 "
" 80	"	4.010 " 4 "
" 90	"	5.079 " 5 "
" 94.143	"	5.559 " 5.6 "
" 102.087 ft. is $\frac{1}{2}$ the length, and	6.500	" 6.6 = $\frac{1}{2}$ [width.

IRON RAILROAD BRIDGES.

For Appletons' Mechanics' Magazine and Engineers' Journal.

SIR—Your correspondent, N. H., in the last number of your Magazine, seems disposed to question the accuracy of my information in relation to the weak point of the Rider Iron Bridge, on the New-York and Erie Railroad, which fell some time last summer.

Now, although my calculation, based upon the proportion of the parts, would show that the tie was unequal to meeting the strain to which it was subjected at a certain point, it by no means invalidates its accuracy to prove that the tie broke *elsewhere*. Imperfect workmanship would account for this; but he goes still further, and affirms that the tie did not break at all!

In answer to this, the Engineer of Repairs informed me by letter "that *one* of the ties at least was found broken." If *one* broke, from any cause whatever, it is a hundred to one that the other did also; without he would have us infer that one tie was equal to sustaining the whole load, which was manifestly not the case.

The officer who first reached the spot informed me by letter as follows: "After the fall of the bridge, such was the state of the wreck that it was impossible from all the examination that was made, to define the first point of failure; and it is probable that the cause of its failure will always remain a matter of doubt."

The superintendent of the road informed me, that from all the information he could gather, "the ties were found completely broken." The Division Superintendent, in his statement to the General Superintendent, made in my presence soon after the accident, said:—"that the bridge was wholly broken up, so completely as to render it impossible to tell at what point it first yielded."

When N. H., in order to show that the expansion of the iron was the cause of its yielding, by cramping the bridge between the abutments, says that, "apprehensive of this result, the bridge inspector called the attention of the officers of the company to the circumstance, in a report, more than a year previous to the accident;" he should have added, what he will find to be the fact—that, acting upon the suggestions in this report, the stone work *had been cut away* for nearly a year previous.

If N. H. is not satisfied with my calcu-

lation of the strength of the Rider bridge, will he be so good as to show the fallacy of it?

Mr. Paker very happily remarks, in a late report to the Baltimore and Ohio Railroad Company, adverting to the use of iron for bridges:—

"It is to be regretted that the late failure of an iron bridge on one of our Northern railways has seemed to throw a panic over the minds of the Directors of that line, and called forth a denunciation of '*Iron bridges*' from some otherwise respectable quarters. The catastrophe, sad as it was, should make us more cautious of adopting the plans of those who, in the capacity of contractors, tempt us with the alleged cheapness of their contrivances, but should surely not destroy our confidence in a material so nearly essential to the success of mechanical practice in almost every department of art and science, and which for this particular purpose has held a high place in the opinions of the most distinguished engineers whom the world has ever seen. As well might we discard iron from use in Naval service because a few chain cables have failed; or cease to use it for wheels and axles, because there, too, it has often disappointed us."

As to the propping of the Whipple bridges, the Engineer of Repairs informs me by note, that "he is not aware of any cause for propping those bridges other than was assigned by the president in his card to the public soon after the failure of the Rider bridge."

The circumstances are these. One of the bridges built by Whipple at the Newburgh branch, differing somewhat in arrangement from those built by him at Binghamton, was placed on a sharp curve, and oblique to the line of road by between 30 and 40°; the trusses but six feet apart, and consequently immediately under the track, were exposed to the centrifugal action of the load passing them, and from their obliquity the struts connecting the trusses in connection with the diagonal swaying rods, were prevented from acting to good advantage in preserving the horizontal alignment of the bridge. To obviate the ill effects resulting from this arrangement, growing out of the peculiar position of the bridge, the builder left directions that, on laying the track, the cross ties should be of good size and *notched on to the truss*, to aid in keeping

the diagonal swaying rods in proper action; the cross struts of the bridge, from necessity, making so acute an angle with the line of track as to impair their action.

This direction of the builder was, it seems, *neglected*, and the convex truss had yielded slightly to the centrifugal action. *The builder, upon being consulted, advised that his original intentions be carried out, as amply sufficient to meet the case.

That this bridge was amply strong there can be no doubt. Although the span was but 27 feet, the tie has the same section as the Rider bridge of 66 feet.

There can be no doubt of the fact, that the proportions of the Rider Bridge were faulty. This, we think, has been shown theoretically, and that it has been practically, the public are well aware.

W.



CHIMNEYS.

GEORGE BUCHANAN, Esq., F.R.S.E., Civil Engineer, lately read at the Royal Scottish Society of Arts, a paper giving an account of the *Chimney of the Edinburgh Gas Works, with observations on the Principles of its Strength and Stability*, in which he concluded with some observations on the effects of draft in a chimney; and as this is a subject of much interest, and one of especial importance in the construction of chimneys for large furnaces, we present our readers with the following summary of the elements of construction, furnished by this distinguished gentleman, viz:

Professor Thomson, of Glasgow, estimates the quantity of air necessary for combustion at 150 cubic feet per minute for each pound of coal consumed, and 50 more for the waste—in all 200. Hence the furnaces of a steam-boiler, using one ton of coal per hour, would require 7466 cubic feet per minute, and as the pipes of marine-boilers are necessarily limited in height, the required draft is had at the expense of a temperature, which is lost for the purpose of evaporation.

The *power of the draft* is stated to be directly proportioned to the height of the chimney, and the velocity with which the

external air rushes in to supply the draft, as proportional to the square root of the height of the chimney. The internal heat however is the grand moving power, expanding the air within the chimney, and giving it a buoyant or ascensional power. At 488 degrees of temperature, the celebrated chemists, Petit & Daloug, and most accurate observers have found that air expands to double its volume. At this temperature, therefore, within the chimney, the velocity with which the external air is capable of entering at its bottom or into its furnaces, would be proportional to the square root of half the height of the chimney, which, expressed numerically in feet per second, is equal to six times the square root of half the

height; or $V = 6\sqrt{\frac{H}{2}}$ V being the velocity

in feet per second, and H the height of the chimney, in feet. This forms an easy rule for this particular temperature.

On measuring the power of a draft, in the case referred to, (the height of the chimney being 330 feet,) a water pressure gauge indicated $3\frac{1}{2}$ inches, there being a good deal of wind at the time.

High winds had a sensible effect on the draft, sometimes raising the pressure gauge to a height of 6 or 7 inches. A pressure of 2.5 inches, which it was in calm weather, is very nearly equal to a column of air half the height of the chimney, and this agrees very well with the preceding formula, as the interior temperature would not exceed 480 or 500 degrees.

As a general rule for calculating the powers of the draft, at any temperature, the following is given as one simple and agreeable to the practical results.

$$V = 6\sqrt{\frac{nH}{488tn}}$$
 n being the number of degrees of temperature.

The results of a number of experiments had with a view to determine the strength of bricks, are also given, but as their composition is not given in detail, and as similar materials of composition are not in use with us, we omit a note of them. A detailed description of this chimney, both as regards materials, dimensions, and construction, is given.

A detailed Description of the above Chimney. By M. TAYLOR, Esq., Engineer for the Edinburgh Gas Works. In this paper Mr. Taylor gave a minute detail of the dimensions and structure of every part of the work. The foundation was on hard shale or clay; the masonry 40 ft. 6 in. square at the bottom, 12 feet below the surface of the ground; 32 ft. 6 in. at the surface of the ground; and brought up by steps in hard foundation courses of Craigleith stone, dressed and square jointed. Masonwork of the most substantial description, with four eyes for connecting the main flues to the stalk. Square pedestal 65 feet high from surface of ground to top of base of brick shaft; 30 ft. 10 in. square at base course; 30 feet square above base, and 27 ft. 9 in. under moulding of top. Body of pedestal of neatly-covered rubble-work of the strongest kind, the stones chiefly from Hailes Quarry of the best rock. The cope mouldings and base of brick shaft of Craigleith. Within the pedestal and rising 20 feet above it, is an inner chimney or brick shaft standing quite detached, having a space from 18 inches to 2 feet clear in every part; this space covered over at the top to keep out soot deposit, but yet left free of the outer pedestal and chimney. The inner chimney is 90 feet high, 13 feet diameter inside, carried up at four different thicknesses, beginning at $3\frac{1}{2}$ bricks thick, and ending at 2 bricks, including a lining of fire-brick, carried up the whole way at two thicknesses—20 feet at 10 inches thick, and 70 feet at 5 inches. The brickwork of the best well-burnt circular stock-brick, with a course of headers in reeled order for every four courses of stretchers. The main brick shaft is 264 feet high above the stone pedestal; making, with the pedestal, 65 feet, and foundation 12 ft. 6 in.—in all, 341 ft. 6 in. The shaft is 26 ft. 3 in. diameter at bottom externally, tapers to 13 ft. 10 in. at the height of 243 feet, at the first belt under coping 11 ft. 10 in. below the top. The shaft is carried up at five different thicknesses, beginning at 35 inches, or $3\frac{1}{2}$ bricks, for 35 feet up, and ending with 15 inches, or $1\frac{1}{2}$ brick, for 58 feet at the top, all built with hard circular composition brick, referred to in the experiments on the strength of bricks. Brickwork put together in the strongest manner with headers, as already described, and best band all laid in the best lime from Burdiehouse, with sharp sand, sifted and made up in the mill. The beds are kept as thin as possible, and neatly pointed-in with the edge of the trowel. All the vertical joints inside of wall, grouted up with thin lime. As a farther security, the shaft is bound with six malleable-iron hoops,

at intervals of 35 feet up, built into the brick-work, one brick on bed from the outside, and kept a $\frac{1}{2}$ -inch clear all round off the outside lining of brickwork, so as to allow the hoops to expand with heat without injury to the work. They are all 3 inches broad; the under three 1 inch thick, the upper $\frac{3}{4}$ -inch each, made in three lengths, clamped together and made fast with three $\frac{7}{8}$ -inch or $\frac{3}{4}$ -inch rivets on each side. The projecting cope at the top is of cast-iron, 19 ft. 6 in. diameter over all, and in sixteen pieces about $\frac{3}{4}$ -inch thick, screwed together with bolts through the flanges. This cope being all fitted and bound together in a mass on the top of the stalk, the brickwork was continued up, and finished with a cope, or plate of cast-iron, composed of eight pieces $\frac{3}{4}$ -inch thick, and about $2\frac{1}{2}$ feet broad, with a round belt going 9 in. down on the brickwork, and forming a strong hoop round it. The chimney is furnished with an endless chain going up the inside of the main shaft, giving the means of ascending at any time to the top. The electric conductor stands 6 feet above the top plate, $\frac{3}{4}$ -inch round copper made fast to stone and brickwork with $7\frac{7}{8}$ inch copper holdfasts let 4 inches into the masonry or brickwork, with a head on the inside and an eye on the outside to receive the rod as it was carried up. By these holdfasts an ascent can easily be made to the top by a small tackle suspended to the holdfasts. The conductor is metallically connected to all the ironwork on the stalk—the plate on the top, projecting cope, malleable-iron hoops, bolts on the top of the stone pedestal, and also the ascending-chain. The rod descends into a well about 10 feet from the foundation, and is immersed about 8 feet deep in water, and the end turned up 2 feet in a horizontal direction, and flattened.

—♦—

To the Editor of *Appletons' Mechanics' Magazine and Journal*.

MY DEAR SIR: Mr. William S. Thomas, of Norwich, N. Y., has very kindly furnished me with a cupping instrument and artificial leech of his own construction, which, in my opinion, promise to supersede every thing of the kind now in use.

I have thoroughly tested them in my practice, and they answer my expectations. Our present instruments of the kind are liable to many serious objections. They are so complicated, that, with the utmost care, they are in constant need of being repaired, and hence cannot at all times be relied upon. Their bulk also renders them inconvenient in country practice.

Of Mr. Thomas's artificial leech I cannot speak in too high terms. It admits of application in all situations, with the same facility as the natural leech, with no possible danger from hemorrhage, or from poison of the bite.

The increasing demand for the natural leech is making great havoc among those varieties that are considered most valuable; and the expense of procuring them will be a serious objection to their employment.

An artificial leech constructed in such a manner as to be efficient, is what has long been needed; and I think that with the present instrument the natural leech can be entirely dispensed with.

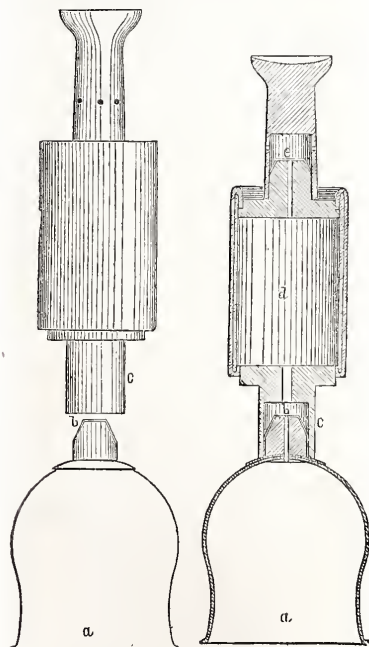
Very truly yours,

H. R. BELLows, M. D.

NORWICH, N. Y. Feb. 10th, 1851.

FIG. 1.

FIG. 2.



The following is a description of the instrument, Figs. 1 and 2—*aa* glass receivers *d* brass cylinder, surrounded by rubber tube, firmly attached with the cylinder to the tubes *cc*; at the top to the piston *e*. At *e* and *b* are oil-silk valves. It will be readily seen that by pressing the piston *e*

FIG. 3.

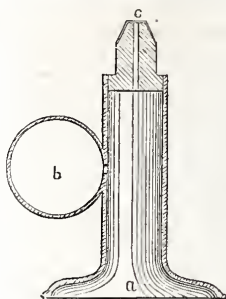


FIG. 4.



down, the air in the cylinder *d* will rush out at the valve *e*, closing the valve *b*. Then, by removing the pressure from the piston *e*, the rubber will contract, bringing the piston to its original position, as seen in the engraving Fig. 2. By repeating this operation, a perfect vacuum may be produced in the cups *a a*.

The piston *e* does not move tight in the cylinder *d*, but is loose.

The rubber when the piston is pressed down, draws tight on the inside of the cylinder, thus displacing the air in a very simple manner.

The exhausting cylinder may be readily attached to the breast glass Fig. 3, making a breast pump; *c* is an oil silk valve; *b*, reservoir; *a*, the mouth to be attached to the breast.

Fig. 4 represents the leech; *a*, glass-tube; *b*, piston. After making the incision with an instrument for the purpose, place the glass tube upon the part; exhaust the air by pressing down the piston *b*, and blood will immediately fill the glass tube *a*.

MISCELLANEOUS.

COMMON SENSE VINDICATED AGAINST THE PRETENSIONS OF MATHEMATICAL SCIENCE.

There is a large class among us who think with James Rock, jr.; to such we commend the perusal of the two following communications made to the editor of the *London Mechanics' Magazine*.

Let it be asked, What is either mathematical or logical science? The answer, as I believe, must be,—It is *the result of an attempt to reduce common sense to rules.*

In one word, it is *method*—a method of thinking, or of recording thought.

The point that I would contend for is this:—that there may be other methods of thought, not recognized as scientific, which may produce results equally satisfactory with those which are so characterized.

Every man may have, and doubtless has, his own method. I have my own, but I freely admit that another may have a better method than mine; then, if he have—he has a better implement than I have, and ought to produce better work. Let us judge of things by their fruits, and inquire how the *facts* really stand. Have the greatest discoveries been made by men of science, or by non-scientific persons? Leaving astronomical discovery out of the question, I have no hesitation in asserting that the balance is clearly against science.

Inventors generally have not been men of great attainments in abstract science, but they ought to have been so, if there be so much value in scientific method as some would maintain.

Yet can it be asserted that they had no method at all? Had Arkwright no method—or Newcomen—or Trevithick? And how long is it since chemistry scraped acquaintance with mathematics?

The fact appears to me to stand thus,—That which is called the inventive faculty is nothing else than the *perception of relation* among given facts. This perception gives rise to the idea of fitness—the fitness of a certain thing or things, employed in a certain manner, for a certain purpose.

I have no quarrel with science: I would only assign to it the "*ex post facto*" position, which is its true one. Let it be employed as an accessory, not as a principal. When the thing has been thought, or done, let science record the process, and thus facilitate its repetition. To deduce formulæ from experiment is its legitimate use, although even in this, as regards physics, its value is frequently uncertain: the variation of a single physical condition, may upset the most logical deduction, or the most accurate computation.

I have endeavored to show that the fundamental mental process is the same, whether it be applied to science, so called, or to science not so called; and that

in no case does any one who uses orderly and consecutive thought for a specific purpose do so without some "method." It is obvious that he cannot. And if a person without any knowledge of abstract science, as such, arrive at the same conclusions as another may do by scientific method, why should any particular preference be shown to the latter rather than to the former, and why should they not be considered equally "scientific," though different? The appeal in both cases, as in every similar case, is to "common sense,"—and in her hands I am content to leave it.

JAMES ROCK, Jr.

Hastings, October 7, 1850.

Mr. Rock is answered as follows:—

SCIENCE AND COMMON SENSE.

Mr. Rock, Jun., is a valorous person, whatever may be said for his discretion. He comes forward as the champion of "common sense;" but he appears to vapor too much at random, to entitle him to the appellation of a true knight-errant.

One would be led to think, from the shape in which Mr. Rock, Jun., and others of his class of philosophers, put the question, that science was something *antagonistic* or *directly opposed* to *common sense*, and that mathematical science was a bugbear, especially to be dreaded, as the most pernicious mental poison, by those who cultivate their common sense;—in short, that in entering upon the study of Euclid, a man took leave of all those faculties which God had given him in common with his fellow men! Else, why that obtrusive and insulting bitterness that invariably forms an ingredient in every such discussion, which is manifested by this class of philosophers?

Before I proceed further, I must notice one important *hiatus* in the papers of Mr. Rock, Jun.:—*the want of a complete, a sufficient and a properly limited definition or description of common sense.* He will tell us, most likely, that "he means by it what every body else means;" and when we apply to "every body else," we shall be told that this multiform personage means by it "what Mr. Rock, Jun., means." But we want it described in *words*, so that no mistake shall arise from this source—the most fruitful of all sources of "shuffle" in matters of reasoning. He

tells us, indeed, what HE THINKS mathematical and logical science are—"the result of an attempt to reduce common sense to rules" (the emphatic italics are his own, and must be intended to direct specific attention to that part of his statement); and then he proceeds to sum up, in what he calls "one word, *method*—a method of thinking, or of recording thought" (p. 310, col. i.); and he finally assigns to science the function of "recording the process" which common sense has devised, so as to "facilitate its repetition" (*ib.* col. ii.). Science (not mathematical alone, but *all* science), is thus reduced to the condition of an amanuensis to common sense—a mere "recorder," at, we may suppose, the wages of a lawyer's clerk, and with pretty nearly the same functions as the laundress's boy who writes a good hand, and is taken (as a special favor, and in reward of the "nice getting up" of his lawyership's linen), "into the office." But, after all, this is pretty much the way in which England rewards her scientific sons—except they happen to have a little "common sense" (*e. g.*, cunning), and their discoveries can be turned to *immediate commercial advantage*. However, we have at least the high authority of Mr. James Rock, Jun., that these things are as they should be: the poor wretches, whom a future age may deem to have been martyrs, are placed for the present in their proper category, and such as he will exclaim—"saves 'em right!" The business of science is to *record the discoveries* of common sense! Let not this be forgotten; but let it not be forgotten, too, that we want to know something more of this more important personage, Common Sense, than Mr. Rock, Jun., has yet told us.

Does Mr. James Rock, Jun., mean by common sense, the common sensitive faculties (sight, hearing, &c.), or the natural power of drawing inferences from things simultaneously perceived to exist? Does he mean the vividness of perception, or the rapidity of inference displayed by the untutored mind? That either of these, so strikingly diversified as we see them, should be deemed common, in any other sense than as that most persons possess a small, and a few a large, share of them, is what I cannot understand. If they be not common in *degree* as well as *character*, the name is ill-be-

stowed. It is, however, a very common sophism, resorted to by the Rock-class, to sometimes mean one and sometimes the other, just as it suits their quibbling purpose to make a change. For this reason I ask—nay, demand—a definition of "common sense."

Mr. James Rock, Jun., gives a very magniloquent, but to me very unintelligible, statement, respecting "specific difference," and "a wider generalization." I have been familiar with these terms, in their ordinary usage, for many a long year; but I am unable "to make head or tail" of the meaning of this extraordinary passage; but having for all those years been a humble votary of science, I must, I suppose, have become incapable of understanding the common sense language of Mr. James Rock, Jun., even if I ever was blest with a single grain of that inestimable article. I have tried it in connection with what Mr. Rock says afterwards in his letter, but with the same result—its meaning being still a mystery.

Mr. Rock is great upon "method"—the discrimination of methods—the better method and the worse method—his own method and other people's methods. He would have the value of methods tested by "the goodness of the work produced by them." I must take shame to myself, but I must own it, that I am profoundly ignorant of the "work" done by this gentleman; and I regret it the more, inasmuch as it would have been an instructive study to compare it with the works of men who are not ashamed to own to science, and even to claim "the lion's share" of that commodity, though so much despised by the self-elected champion of "common sense." *Mathematical science* it is, be it remembered, he means; for in conclusion of his sentence, he *elegantly* asks—"How long is it since chemistry scraped acquaintance with mathematics?" But to proceed.

"Let it (mathematical science) be employed as an *accessory*," says he, "not as a *principal*. When a thing has been thought or done, let *science record the process*, and thus facilitate its repetition. TO DEDUCE FORMULA FROM EXPERIMENT IS ITS LEGITIMATE USE!" What will Mr. James Rock, Jun., say when he is told that, instead of being the legitimate use of mathematical science, it is not even a use that can be, or ever will be, made of

it? The formation of empirical formulæ—the “legitimate use” of mathematics! In what book has he found this confusion of ideas? I know of none, and hence infer that Mr. James Rock’s “common sense” is not quite so free from opaque spots as he fondly assumes it to be. The legitimate use of mathematics, let me inform this gentleman, is to deduce the properties of figure and number; its application to physics at all is only collateral, and forms no part of the essential and fundamental objects of the science. It has been *adopted* by the physical inquirer, because he found it afforded him aid in his researches; but physical science was not taken under the wing of mathematics for the sake of affiliating or legitimatizing it. It was the *physicien* who sought the aid of mathematics—not the mathematician who sought the aid of physics. Physical inquirers as well as mechanics may (and often do to a great extent, though not so much as they think), reject the aid which others of those classes seek. That is a matter for their own convenience, understanding, or special subject to decide upon; but, in general, those inquirers who do not invoke the aid of mathematics, are those who do not possess the “spell of invocation”—those who, from *ignorance of the science, can form no idea as to how it is to be used.*

As Mr. Rock has mistaken the functions of mathematical science in the aid she offers to physical inquirers, it may be as well to state what those functions really are. It is neither more nor less than to *deduce the consequences of any assumed law of force by which bodies act on each other*—or, if it will be more intelligible under this form, *the consequences of any physical hypothesis.* Then comes the business of the experimentalist and the observer, to ascertain whether these consequences are fulfilled, and hence decide upon the truth of the hypothesis itself. The business of the mathematician, strictly speaking, ends where that of the observer begins: though it often happens that even in the conduct of the observations themselves, the mathematician is able to afford important aid—especially by the subsidiary contrivances he may make for facilitating the reduction of the observations to a manageable form. This, however, is incidental. In mechanism again, the business of the mathematician

is to *predict* the result of any proposed combination of geometrical observations. It neither is based upon, nor requires, the slightest amount of experiment; but it *supersedes the necessity for experiment altogether.* The mechanists of the school of Mr. Rock may, if they please, get the same results by experiment,—or half by guess, and the other half by experiment, if it so please them: but he who understands how to apply mathematics to such a purpose, may justly value the greater facility with which he can decide the question on paper. All I wish here is simply to express *what really are* the proper functions (or “pretensions,” as Mr. Rock so insultingly terms them), of mathematical science when its aid is sought by the physical inquirer or the mechanist.

It is, indeed, true enough that there are plenty of persons calling themselves mathematicians, but whose title to the character is as dubious as in that of many claimants to common sense to the character they assume. Pretensions for mathematical science may be put forward by these persons, on the same ground as their pretensions to it. Still these are far more rare than the cases where all the common sense in the world is arrogantly claimed by men who are innocent of science in all its (to them) hideous forms. Such arrogance rather proves the want of common sense than the sole possession of it; just as the corresponding arrogance of the *soi-disant* mathematician proves his ignorance of its principles, its character, and its functions. It is sheer impertinence and charlatanism in both cases.

Mr. Rock has recurred to the hacknied topic of the “inventive powers of the educated and the uneducated man”—of the man of science and the man of common sense. He has, it seems, to be told that the inventive faculty and the reasoning faculty are altogether distinct; and that the one may be developed very amply where the other is totally neglected. The inventive faculty is more nearly akin to the poetic than to the logical. The power of mental combination, whether of wheels and pinions, of natural phenomena, or of the words that produce agreeable or painful associations,—mechanical, physical, and poetical combinations—are *acts of imagination,*

not of reasoning. Reason, experiment, or taste, may step in *afterwards* to discuss their fitness; but in themselves they are purely imaginative. I believe, too, that as a general rule, the mind that is less concurrently alive to the reasoning part of the process is more likely to dash on further in breathless haste, than the mind that is better trained to heed the character of the steps it takes. It thereby arrives at results that would seldom be attained by a more cautious speculator—it invents therefore, more frequently. But who can tell the numberless schemes thus “dashed out,” that only bring disappointment and ruin to the inventor? We see only the bright side—the successful invention. Nor do we envy it; the inventor has risked much—thought much—worked much; and all these under especial disadvantages. But under these especial disadvantages, Mr. Roek would still confine himself! Advice like this is the bane of our workshops—the bane of our ablest workmen—and the bane of society, too, when given with the pompous authority of this champion of Common Sense. Is it to be alleged that because a Brindley could scarcely write his name, a decent and legible calligraphy is destructive of the genius of an engineer? On the contrary, what thought the gifted, but uneducated, George Stephenson? *Feeling* the disadvantages under which he labored, did he not give his own and only son the best education he knew how to obtain? And has that education (*scientific*, we should suppose,) rendered Robert Stephenson a worse engineer or a less inventive person than he would have been, left to the dictates of his common sense? No; they alone despise and deride scientific acquirements who are themselves destitute of them. We never find a man who has made any progress in any science whatever speak despairingly of it; he knows that it gives him greater power than he would have possessed without it; and he values it accordingly. He may regret that his acquirements are limited; he may, if he be competent to judge to that extent, regret the limits to which the science itself has been cultivated are so narrow; but he never vilifies it as useless, nor sneers at it as so inferior to what his common sense would have led him to.

We should be tempted to think from

the pretentious manner in which Mr. Roek puts forward his list of mere truisms, almost “methods,” that he imagined they contained some illustrious discovery. I fear he left school too early, and too early set up as philosopher on his own account. It seems he has yet to learn that philosophers of the “senior class” view science and method as one. Methods more or less perfect are only sciences more or less perfect. Every one is based upon previous knowledge, upon previously-acquired science. It is true, that a semi-idiot may imitate, as a monkey can imitate; and that a very mindless person may chatter as cleverly as a parrot. There may be, and there are, many workmen (and good workmen too at straight-forward work,) who have learnt their trade without thinking of its principles: but these are not the inventors, nor are they capable of inventing. There is however a large amount of traditional science in our workshops—often, indeed, expressed with a peculiar technicality that renders it difficult for a stranger to seize its import—generally limited in its applications to some particular trade, and very imperfect and one-sided at the best. But there it is: and this it is which constitutes the science and forms the foundation of “method”—not the indefinite and hitherto undefined phantasm called “common sense.” Imperfect, very imperfect indeed it is; but as far as it goes, it is to all intents and purposes SCIENCE.

I am at a loss to discover upon what particular point of Mr. Davies’s “Notes,” Mr. Roek fastens his strictures. I certainly thought that that gentleman went a great way in showing to what degree geometry might be carried without the aid of technical logic; by “common sense,” if I understand his critic. It is certainly a concession which no preceding geometer has made; and I suspect he will find but few who are prepared to go to the extent he does. But I leave this question to be settled between themselves; if indeed Mr. Davies shall think this “common sense” philosopher worthy of his notice. I am, Sir, &c.

JOHN LOCKE, Senior.

London, October 21, 1850.

HYDRAULIC PRESSES.

In most cases hydraulic presses fail by splitting vertically down the centre, and on account of the incompressibility of

water, the fracture is generally quiet and gradual. In consequence of the frequency of such failures, it has been supposed by some experienced makers, that after being for a certain time exposed to so great a strain as three tons per circular inch, all cylinders will ultimately fail. There appears, however, after careful inquiry, no good grounds for this conclusion; the imperfection of the safety valve renders it at all times doubtful what pressure is actually employed; and most cases of failure may be traced to some unusual pressure. An 18-inch press has been in constant use many years by Mr. Amos, the pressure being always three tons, and on some occasions four tons per circular inch. In some extensive works at Dover, where large hydraulic presses are used for drawing oil, five double and two single presses have been long in use; the pressure is constantly upwards of three tons; three cylinders have failed, and were all found to be defective castings; and one double press has been up 102,000 times.

Wrought iron would doubtless give perfect security; but the construction of such large cylinders (as used at the Britannia Bridge) would be next to impracticable. Brass presses are sometimes used, and the ram is sometimes successfully lined with brass to lessen the wear.

The area of the large press for the Britannia Bridge was 314.16 square inches, and the capacity with a 6-feet stroke 2216.5 cubic inches. The quantity of water employed for a 6-feet lift is therefore 81.57 gallons = 815.7 lbs.

The pressure at three tons per circular inch = 3.819 tons per square inch, which would raise a column of water 5.41 miles in height; this pressure would therefore be sufficient to throw water over the highest mountains on the globe. The ratio of the area of the pump to that of the cylinder is as 1:354.3.

It is evident that, instead of a force pump, a head of water may be conveniently employed for forcing water into the cylinder; and in this manner power may be stored up ready for use. The hydraulic press in this form is used for working cranes, for unloading vessels, and other purposes where a more rapid motion is requisite.

In all cases where great pressure is required, the steady character of its action

adds greatly to its utility; among other uses, it is extensively employed for compressing wool and hay, to facilitate packing for drawing oil from seeds, for drawing lead and pewter pipes, for glazing paper (commonly called hot-pressing), for raising vessels in dry docks, for raising turn-tables and swing-bridges on a vertical pivot to facilitate their circular motion, for pressing metals into moulds; and, in a portable form, a small press forms a very convenient substitute for the screw-jack, and has been extensively employed in moving heavy weights during the construction of the Britannia and Conway Bridges.—*Clark's Britannia and Conway Tubular Bridges.*

PIRSSON'S FRESH WATER CONDENSER.

This condenser has been used with success on board the *Osprey*, running between Charleston and Philadelphia.

The peculiar feature of this condenser, which distinguishes it from all others, is the placing of the condensing tubes horizontally within the ordinary shower condenser, which is made of enlarged dimensions for the purpose. By this arrangement, the water required for condensation is admitted through the ordinary injection cock, and rises to the top of the external condenser, where it is discharged on a scattering-plate, from whence it passes directly on to the tubes of the internal condenser, which are below it, and arranged in three ranges or sets, one above the other; the steam from the cylinder is admitted into the upper range, and passes through the three before being discharged at the bottom. The fresh water produced by the condensation of the steam is pumped out by a small pump, and immediately returned to the boilers, while the water used to produce condensation is taken out by the air pump of the engine. The internal condenser is not attached to the external one, but merely laid in it. The three ranges are separately made, and the outlet from the upper slips loosely into the one below it, so that when the whole internal condenser is together, it may be moved from one-eighth of an inch to one-fourth of an inch in any direction. This freedom prevents any liability to fracture from unequal expansion, and the tubes being in vacuum relieves them from all

pressure. As the condensing water reaches the bottom of the tubes, it is immediately pumped out, so that there is not at any time any water around the tubes other than the thin sheet passing over their surfaces. On the *Osprey*, the vacuum within the tubes of the internal condenser is 26 inches, and the same in the external one; the interval vacuum is the result of condensation, while the external vacuum is produced by the air pump. The *Osprey* has no trouble in keeping a full supply of fresh water in her boilers.

MALLEABLE BRASS.

Ordinary brass, which consists of 27.4 to 31.8 per cent. of zinc, and 71.9 to 65.8 per cent. of copper is brittle when hot, and can only be used for casting. There exists, however, an alloy of copper and zinc, which can be wrought like iron. The first specimens examined consisted of 34.76 zinc and 65.03 copper. Mr. Machtz fused together 33 parts copper and 25 zinc; there was a loss of three parts, and the resulting alloy contained 60 parts copper to 40 zinc. It was more malleable than the first-mentioned specimens. Dr. Elsner obtained an alloy by fusing together 60 parts copper and 40 zinc. The metal obtained had a specific gravity of 8.44, and appears to consist of (3 Cu. + 2 Zn). It is harder than copper, tough, close-grained, and perfectly malleable. Care should be taken to prevent dissipation of the zinc during fusion.

METHOD OF ASCERTAINING THE VALUE OF INDIGO.

Dr. Bolley, after showing the inaccuracy of the methods of Chevreul, Schlumberger, &c., recommends the following process: 1 gramme of indigo, (15.4 grains) is rubbed to a fine powder in a porcelain mortar; about 10 grammes of fuming sulphuric acid are added, and it is then kept covered for six or eight hours, being occasionally stirred. The whole is then put into an evaporating dish, containing 2 lbs. of water; 50 grms. of concentrated hydrochloric acid are added, and the mixture is boiled. The water is replaced as it evaporates. Meanwhile, a $\frac{1}{4}$ gram. of warm dry chlorate of potassa in fine powder is dissolved in 100 grms. of water, in a graduated tube, hold-

ing 100 cubic centimetres of water. This is then added to the indigo solution, at first pretty freely, but afterwards more gradually, allowing the mixture to boil after each addition. The liquid changes from blue to green, greenish-brown, and at last into a red-brown. These changes may be observed by marking a piece of white filter from time to time with a rod dip in the solution.

SOLUBILITY OF THE SULPHITE OF LEAD.

A new process has lately been patented for the refining of sugar, which consists principally in throwing down the impurities contained in a saccharine solution with sub-acetate of lead, and removing any excess of lead by means of a current of sulphurous acid gas. The great insolubility of the sulphite of lead thus formed allows the entire removal of the metal. As, however, from defective management, traces of lead may, and occasionally do, remain in the sugar and treacle thus prepared, it becomes a question of some importance to ascertain what are the effects of sulphite of lead upon the animal system. Dr. Gregory and Mr. Brande represent it as perfectly safe and harmless. The former of these chemists rests his opinion upon a series of experiments in which the sulphite was administered to various animals, without any symptoms of poisoning becoming manifest. To be conclusive, however, these experiments should have been continued for a longer time. The action of lead upon the body is exceedingly slow and gradual, and when given in so insoluble a form, and in fractional doses, months might easily elapse before any symptoms of disease became apparent. Moved by these considerations, Mr. Redwood has instituted a course of experiments (published in the "Pharmaceutical Journal"), on the solubility of the sulphite of lead, not in distilled water, which, as he rightly remarks, is of little practical moment, but in those chemical agents which are ordinarily met with in the stomach.

1. *Action of Water and Acetic Acid on Sulphite of Lead.*—Sulphite of lead was prepared by transmitting sulphurous acid gas through a solution of the acetate. The whole of the lead was found to be thus precipitated, and none could be detected in the liquor, even after standing

in contact with the precipitate for some days.

2. *Action of Hydrochloric Acid on Sulphite of Lead.*—Water acidulated with hydrochloric acid speedily decomposes sulphite of lead; and the liquor, after standing for some time, affords a white precipitate of carbonate of lead, on the addition of carbonate of soda, and an abundant black precipitate with sulphuret of ammonium.

3. *Action of Chlorides of Ammonium and Sodium.*—On macerating sulphite of lead in solution of chloride of ammonium the liquor was found largely impregnated with lead, and yielded precipitates with carbonate of soda and sulphuret of ammonium. The action of chloride of sodium was less marked, the tests affording only a slight indication of the presence of lead.

4. *Action of Lactic Acid on Sulphite of Lead.*—The liquor resulting from the maceration of sulphite of lead in a weak solution of lactic acid afforded evidence of the presence of lead in small quantity, the amount being rather greater than that taken into solution by the action of chloride of sodium.

5. The sulphite of lead being acted upon so quickly, and the lead rendered soluble by hydrochloric acid, it was concluded that free hydrochloric acid, added to a weak solution of a soluble salt of lead, would prevent the precipitation of the lead by sulphurous acid; and this was found to be the case. A solution, prepared as above, in which sulphurous acid gave no precipitate, afforded precipitates with carbonate of soda and sulphuret of ammonium.

6. *Action of Carbonate of Soda on Sulphite of Lead.*—With the view of determining whether the affinity between sulphurous acid and oxide of lead be so powerful as to prevent the formation of carbonate of lead, 10 grs. sulphite of lead were added to a solution of 20 grs. carbonate of soda in 4 oz. distilled water. After standing for two or three days, without the application of heat, the insoluble salt was collected on a filter, and treated with dilute acetic acid. The liquor thus obtained gave copious precipitates with carbonate of soda and sulphuret of ammonium; thus proving that

the sulphite had been partly converted into carbonate by the action of a weak cold solution of carbonate of soda.

REVIEWS.

Treatise on the Steam Engine, in its application to Mines, Mills, Steam Navigation, and Railways. By the ARTISAN CLUB. Edited by JOHN BOURNE; and illustrated by twenty-three plates, and three hundred and forty-nine engravings on wood. D. Appleton & Co. 1851.

Of the many treatises on the Steam Engine, of which there are nearly one hundred, this is without doubt the most comprehensive; and the historical part, which in many of them is a mass of contradictions, is here well sifted and arranged to the exclusion of all irrelevant matter; and the view which he takes of the relative importance of this branch of the subject, which, being mere compilation, is usually dwelt upon to the manifest annoyance of the reader, is a just one. He says:

“A treatise on the Steam Engine would, we suppose, hardly be reckoned orthodox if it began in any other way than with an account of the doings of Savery, Papin, and the other patriarchs whose names figure in the history of steam invention. The devices indeed of these ancient worthies bear very little resemblance to the modern steam engine, and can throw but little light upon its structure or mode of operation; but it was out of these primitive contrivances that the modern steam engine arose, and they derive a sufficient dignity from that relationship to make them the objects of a just curiosity. We think, therefore, that some slight sketch of the expedients employed in the early career of steam improvement is but a reasonable prelude to a Treatise on the Steam Engine, and is indeed indispensable to the integrity of such a work: but we fear our qualifications for the task are by no means so conspicuous, for delineations of this kind require a light and graceful pencil, and become intolerable in the hand of a vulgar limner. The great art lies in saying just as much as the necessity of the case requires, and nothing more; for a history of the steam engine is the least important part of a treatise on that subject, and only deserves a space answerable to its insignificance; whereas by needlessly expanding this part

of the work, or by elaborating trivial schemes into importance, the proper subordination of objects is destroyed, and all those discriminating shades are obliterated which constitute the excellence of the picture. To all this we must add that people in these utilitarian days have neither time nor inclination to listen to long-winded descriptions of exploded projects in steam machinery, though they might like well enough to know something of the nature of those expedients if it can be told them in a few words: But they are not likely to perplex themselves with such inquiries as, who first forced water above its level by steam pressure, or solicited it to rise by a partial vacuum? and to say the truth, such inquiries appear to us of about as much importance as the researches of those learned grammarians, who spend a lifetime in restoring a dative case, or adjusting a metre or an accent. The task, too, of resolving these frivolous problems is quite as tedious a one as that undertaken by the learned persons aforesaid; for after having ascended through history, by a most toilsome progress, to the first person guilty of disturbing the equanimity of water by steam pressure, the shade of some learned recluse who flourished in ancient times in China it may be, or Japan, will probably rise up with proofs of a still higher priority, and the idol just set up for universal adoration will be cast into the dust by this new authority, to be overthrown in its turn by the researches of subsequent inquirers. The fact appears to be, that the power of steam to raise water above its level was widely known in very ancient times, and appears to have been occasionally employed by the Greeks and Egyptians for trivial, or rather for unworthy, purposes: but it is in modern times only that steam has been adapted to ends of weight or utility, and the history of the steam engine properly begins with that application.

"It is not to be expected that the historical narration on which we are about to enter should contain much that is new. The facts with which we must necessarily deal have often been stated before, and we believe now admit neither of much increase nor modification; but it is not impossible, we think, to set these facts in truer lights, and to deduce from them sounder conclusions than have yet been realised. It appears to us to be a vice of many commentators, that they have attached too much importance to the deeds of individual projectors, and have estimated at far too low a rate the current intelligence of the time, of which indeed the proficiency of those exalted persons is to be regarded as merely the exponent. They have set down

the early progress of the steam engine as due altogether to the perspicacity and contrivance of a few solitary adventurers, without hinting that some part of it might reasonably be ascribed to that spread of information and general advancement of knowledge to which that progress is in truth mainly attributable. The consequence of this fault is, that a host of projectors are made to 'shine aloft like stars,' whose merit, when tested by the general information of their own time, fades into insignificance. They stand, it is true, in the van of improvement, but the elevation due to the existing state of society is measured as a part of their intellectual stature; and while they are each presented to the imagination like a precipice starting abruptly to the skies in solitary and awful majesty, they are in truth only to be regarded as so many heights, which, whatever be their absolute altitude, rise only a few feet above the other heights around them. It is absurd, therefore, to seek to elevate any of the early projectors of the steam engine into greatness, for they were one and all persons of only ordinary intelligence and assiduity, of which every age has produced its thousands; and the progress they made was owing rather to the natural flow of events than to any great genius or foresight on the part of any one of them. It is still more idle to set down any one of these persons as the *inventor* of the steam engine. Great inventions are necessarily of a slow growth, and are rarely the produce of individual minds, but require time and experience as well as ingenuity to bring them to maturity, and indeed the happiest steps are sometimes the effect of accident. In the intellectual as in the material world, the most precious productions are those which cannot spring to perfection at once, and it would be as reasonable to inquire to what refreshing shower, or to what gleam of sunshine, the stature of a stately oak is attributable, as to what individual mind we are indebted for the creation of our modern steam engine. The exertions of different minds are merely so many agencies that have been happily conducive to a great result; and it would be as just to assign the invention of our modern men-of-war to Jason, as to assign the invention of the steam engine to Savcry or De Caus.

"But whatever be the merit that is due to these 'sons of notoriety,' it is we think divisible only among those of them who have been instrumental in working out some practically useful result. The mere men of speculation, who have suggested modes of doing things, but have never done them, are not to be ranked with those who have really accomplished

something, in a case where the whole difficulty of the task lies in its practical achievement. Whatever else these ingenious persons may be, they are certainly not among the number of the improvers of the steam engine; and their claims, if to be considered at all, ought in strictness to be considered as the claims of a distinct class of persons. Nor can the merit of such a class, under ordinary circumstances, be considerable, for there is nothing more easy than to originate vague ideas of improvement, though it is generally a very difficult thing to carry those ideas into successful practice. M. Arago, however, and his followers it seems, have set the steam engine down as a French invention, because Solomon de Caus first adopted the idea of steam as a motive force, and Papin suggested the application of the cylinder and piston. It would be as reasonable, in our apprehension, to set down the battle of Waterloo as a French victory, because Napoleon adopted the idea of fighting it; for the question in all such cases is, not who first adopted an ideal result, but who actually realised that result in practice. The scheme of Solomon de Caus was neither useful nor new, and Papin's project was so impracticable, that he himself abandoned it in favor of Savery's scheme. We have no evidence that either of those persons ever completed an engine of any kind. Papin's scheme, as he first proposed it, was worse than the previous project of the Marquis of Worcester, for it was without a boiler; and after several gyrations he certainly left the steam engine in as imperfect a state as if he had never meddled with the subject. If, therefore, we were disposed to retort upon M. Arago his pitiful nationality, we might with some plausibility say that his proofs only show the lamentable barrenness of the French intellect; for the very ideas which, in the minds of Englishmen, have quickly grown up to a rich maturity, and have blessed all nations with countless new enjoyments, have, when implanted in the minds of Frenchmen, invariably failed to produce any useful result. But this is idle. The steam engine happens, no doubt, to be from first to last an English invention; but that result, we conceive, is not so much to be attributed to the superior genius of the English people as to the force of circumstances, which made some such instrument as the steam engine more valuable to England than to other nations. If France had possessed valuable mines lying under water, and at the same time an abundance of coal ready to be made instrumental for their recovery, there is every reason to suppose that the steam engine would have been a French invention;

and we think the consideration that our honors are the result merely of accident, ought to reconcile that ingenious people to a priority it is idle to contest. No nation can be expected to excel another nation of equal power and intelligence in every thing; and if it be the fact, as we willingly admit, that the French excel us in some things, they must be content to give us the palm in others, one of which certainly is steam engineering.—There is no end, however, of these speculations, and we fear they are neither very captivating nor very convincing; so that we shall here cut them short, and proceed without further preamble to the history of the invention. The history of the steam engine is divisible into five great epochs. The first extends from the times of the ancients to the first effectual application of the boiler, which appears to have been accomplished by the Marquis of Worcester, and it was this single step that turned the toys of Hero and De Caus into a true and useful steam engine. The second epoch is distinguished by the employment of a vacuum as an aid to the simple pressure of the steam. The third epoch relates to the successful application of the cylinder. The fourth to the condensation of the steam by injection, to the movement of the valves by the engine, and to the various improvements in detail, which were carried into effect by Smcaton. The fifth epoch is that distinguished by the application of the condenser, and the other improvements of Watt, which brings down the history to our own times; as since the steam engine left the hand of Watt, no improvement involving a new principle has been added to the list. Under each of these heads we have a few observations to offer.

We recommend the work to our readers as one every way worthy of their confidence, and of a place on the shelf of any engineer, or mechanic, let him occupy what position he may in his profession.

History, Structure, and Statistics of Plank Roads in the United States and Canada.
By W. KINSFORD, C. E. on Hudson River Railroad; with remarks on Roads in general, by G. F. G. SKINNER.

This little work addressed less to the professional man than the farmer, and others immediately interested in cheap and easy intercommunication, contains many facts not elsewhere in print—and as the subject is one

of growing importance to all, it will well repay a perusal.

The local effects already perceived as growing out of this method of road-making, will, it is hoped, call the attention of capitalists, already alive to the value of long lines of railroad improvement, to the equally valuable—and as an auxiliary to the railroad by no means to be despised—Farmer's Road.

Report of Commissioners appointed by command of her Majesty to inquire into the Application of Iron to Railway Structures. (Presented to both Houses of Parliament. 1849.)

Iron applied to Railway Structures. By G. D. DEMPSEY. 1849.

Continued from page 116.

Power of beams of cast-iron to sustain long-continued impact.

"The effect of impact and vibration upon structures was a leading object of inquiry with the Commission; and the first series of experiments instituted upon this subject was, to determine the power of beams to sustain impacts many times repeated. For this purpose sixteen bars were cast, and five at least of the sixteen were found to be slightly defective at some place where they gave way. Whether these small defects were more numerous than would be found in practice, it would be difficult to determine. Six of the bars were 15 feet long and 3 inches square, and placed on supports 13 feet 6 inches asunder; seven were each 10 feet long and 2 inches square, and 9 feet between the supports; and three were each 5 feet long, 1 inch square, and $4\frac{1}{2}$ feet between the supports. Of these bars, six were bent through one-third of their ultimate deflection at each blow, and five of them bore each 4,000 blows without breaking; the sixth was broken at a flaw with 1,085 blows. One large bar, bent by impact through five-twelfths of its ultimate deflection, was broken at a defective place with 1,350 blows. Of six bars bent by blows through half their ultimate deflection, five were broken with less than 4,000 blows each; one with 29; another with 127, &c. The only bar which bore the 4,000 blows was one of the smallest kind, or 1 inch square. Of three bars, one bent to seven-twelfths, and two to two-thirds the ultimate deflection, all were broken; the two latter with 127 and 474 blows respectively; the former required 3,700 blows

to break it. Of ten bars of Low Moor Iron No. 2, each ten feet long and 2 inches square, placed on supports 9 feet asunder, and struck in the middle with long-continued impacts, as before, four broke at defective places, and two at sound ones. Three were subjected to impacts bending them through one-third of their ultimate deflection, and bore the test without fracture: of three bent by blows through half their ultimate deflection, two were broken; those bent through two-thirds were all broken. On the whole, it appears that no bar but one, and that a small one, stood 4,000 blows, each bending it through half its ultimate deflection; but all the bars, when sound stood that number of blows, each bending them through one-third their ultimate deflection. It must, however, be borne in mind, that a cast-iron bar will be bent to one-third of its ultimate deflection with less than one-third of its breaking-weight, laid on gradually; and one-sixth of the breaking-weight laid on at once, would produce the same effect, if the weight of the bar was very small compared with the weight laid on it. Hence the prudence of always making beams capable of bearing more than six times the greatest weight which will be laid upon them." Mr. Hodgkinson makes the following

Remarks on some of the leading results of horizontal impacts upon cast-iron beams:

"1st. The bars in Tables I., II., and III. were of the same sectional area, length, and weight, nearly, but differed in the form of their transverse section. They were placed on supports at the same distance ($13\frac{1}{2}$ feet) asunder, and struck horizontally by the same ball, 603 lbs. weight, suspended by a radius of 17 feet 6 inches. From the results, it appears that the beam 3 inches square, and the rectangular beams $6 \times 1\frac{1}{2}$ inches section, struck on the broader and narrower sides respectively, had all very nearly the same strength to resist impact. These conclusions are drawn from a mean between two experiments in each case. In Table XV., six bars, each 2×1 inch section, and 5 feet long, were laid on supports $4\frac{1}{2}$ feet asunder, and all struck by the same ball, $75\frac{1}{2}$ lbs. weight, with arcs of a radius 17 feet 6 inches. Three of them were struck on the broader and three on the narrower sides, and their mean chords of impact to produce fracture were 70 inches and 71.67 inches respectively, or nearly the same, agreeing with the results of the experiments upon the former bars."

"2nd. In Table IV. the bars were of the same dimensions in section as those in Table I., or 3 inches square, but the distance be-

tween the supports was reduced one-half. The resulting breaking deflection, 1·23 inch, was somewhat greater than one-fourth of that in table I., or 4·875 inches, and the vertical descent to produce fracture was nearly one-half, but rather more, the depth fallen through in the two cases being ·639 inch and 1·238 inch. Comparing, in like manner, the half and whole bars in Tables V. and II., the depths are ·5521 inch and 1·2071 inch respectively. This result, coupled with the former one, shows that the depth fallen through to break the half bar is nearly half of that required to break the whole one. Comparing the results in Tables VIII. and XII., and also Tables X. and XIII., it appears also that a bar of half the length of another resists with nearly half the energy, but somewhat more.

“3rd. The experiments in Tables I., II., III., IV., and V. afford illustrations of some of the conclusions in the large generalization of Dr. Young, deduced from neglecting the inertia of the beam. (*Nat. Phil., Lecture XIII.*) ‘The resilience of a prismatic beam, resisting a transverse impulse, follows a law very different from that which determines its strength, for it is simply proportional to the bulk or weight of the beam, whether it be shorter or longer, narrower or wider, shallower or deeper, solid or hollow. Thus a beam 10 feet long will support but half as great a pressure without breaking, as a beam of the same breadth and depth which is only 5 feet in length; but it will bear the impulse of a double weight striking against it with a given velocity, and will require that a given body should fall from a double height in order to break it.’

“4th. The experiments in Table VI. were made to compare the effects of striking a bar midway between the centre and one support with those of striking similar bars at the centre, as in Table IV. The great impacts, so near to the support in these cases, would necessarily cause it to yield slightly, and thus increase the resisting powers of the bars to sustain impact. In experiments made by the author several years ago, given in the Fifth Report of the British Association, page 112, on bars 1 inch square—some subjected to impacts in the middle, and others at half the distance between the middle and one support—the cord of impact necessary to produce fracture was nearly equal in the two cases. The ratio of the deflections, from equal impacts at the middle and at one-fourth span, was nearly constant under different increasing degrees of impact: the deflections at the middle from equal impacts being those at one-fourth span as 10:7 nearly. The relative ultimate deflections of the

beam in the middle, and at a point half way between the middle and one end, ought to be as 10:7·5 nearly.

“5th. The bars in Tables VIII., IX., and X. were all of the same iron and size, and the only difference was in the weight of the striking balls. The distances fallen through, and the work done by the balls to produce fracture being respectively ·3159 and 190 488 with the 603 lbs. ball, 1·2856 and 194·447 with the 151½ lbs. ball, and 3·0506 and 230 32 with the 75½ lbs. ball, affording a good illustration of the resistance from the weight of the bar.

“6th. The bars in Table XI. were of the same iron as the others, but remelted, to ascertain the effect of melting this iron a second time, without mixture, upon its power to bear impact. The strength to resist blows was increased, but the iron was harder and much more unsound than before. The work done by the ball to break the beam in each case was increased in the ratio of 261 to 194.

“7th. The deflections in cast-iron beams were always found to be greater than in proportion to the velocity of impact; whilst in wrought-iron they were nearly constant with impacts of very different velocities. This fact shows that there is a falling off in the elasticity of cast-iron through impact, analogous to that through pressure. The difficulty of obtaining a satisfactory theory of the power of cast-iron beams to sustain impact is considerably increased by this falling off in elasticity, but it is hoped that the varied nature of these experiments will tend much to reduce it.”

Appendix B contains a report of experiments for determining the effects produced by causing weights to travel over bars with different velocities, made in Portsmouth Dockyard, and at Cambridge, by the Rev. R. Willis, F.R.S., Jacksonian Professor, &c., Capt. H. James, R.E., F.R.S., and Lieut. D. Galton, R.E., together with experiments made in Portsmouth Dockyard on the strength of rectangular bars of cast-iron: on the effects of reiterated depressions of iron bars, by traversing weights, &c., &c., with a “Preliminary Essay,” by the Rev. R. Willis, on the effects produced by causing weights to travel over elastic bars. The bars in all the experiments were laid in parallel pairs, and tested by passing a loaded ear at various rates of velocity over them. The first series of these experiments were

made with bars of cast-iron 9 feet long between the points of support, 1 inch broad and 2 inches deep. The weight of the load was increased at each transit till one or both of the bars broke, the velocities being obtained by letting the car run down an inclined plane from various heights. In *Experiment No. 4*, the car at rest on the centre of the bars, weight 1120 lbs., caused a deflection of $\cdot 88$ inch, and a set of $\cdot 20$ inch. The same load impelled at the velocity of 15 feet per second, or 10·2 miles per hour, produced a central deflection of 1·24 inch, and a set of $\cdot 21$ inch. 1760 lbs. at the same velocity produced a central deflection of 3·00 inches, and a set of $\cdot 91$ inch. An ultimate load of 1876 lbs. broke one of the bars. *Experiment No. 5*, load 1120 lbs. at rest, deflection at centre $\cdot 86$ inch, set $\cdot 25$ inch. Same load at velocity of 10·2 miles per hour increased deflection to 1·11 inch, the set remaining the same. A load of 1844 lbs. increased the deflection to 4·17 inches, the set to 1·59 inch, and eventually broke one of the bars. In *Experiment No. 6*, a load of 1120 lbs. at rest on centre of bars produced a deflection of $\cdot 62$ inch, and a set of $\cdot 12$ inch. The same load, passed at the rate of 10·2 miles per hour, increased the deflection to $\cdot 74$ inch, with the same set as before; a load of 1792 lbs. at the same speed deflected the bars 2·90 inches, with a set of $\cdot 67$ inch; and a load of 1816 lbs. broke one of the bars. In *Experiment No. 7*, a load of 1120 lbs. at rest upon the centre of the bars caused a deflection of $\cdot 64$ inch, and a set of $\cdot 12$ inch. The same load propelled at the velocity of 24 feet per second, or about $16\frac{1}{2}$ miles per hour, increased the central deflection to 1·02 inch, and the set to $\cdot 15$ inch. A load of 1412 lbs. at the same speed produced a deflection of 3·16 inch, and a set of $\cdot 72$ inch; and a load of 1440 lbs. broke both bars. In *Experiment No. 8*, 1120 lbs. at rest on centre as before, showed a deflection of $\cdot 65$ inch, and a set of $\cdot 11$ inch. A velocity of 24 feet per second increased the deflection to $\cdot 87$ inch, and the set to $\cdot 14$ inch. 1496 lbs.,

at the same velocity, produced a deflection of 3·94 inches, and a set of 1·07 inch; and 1524 lbs. broke both bars. In *Experiment No. 9*, a load of 1120 lbs. at rest on the centre, deflected the bar $\cdot 74$ inch, with a set of $\cdot 18$ inch. The same load, at a velocity of 24 feet per second, caused a deflection of 1·14 inch; and 1580 lbs., at same velocity, produced a deflection of 3·08 inches, and a set equal to $\cdot 68$ inch. 1604 lbs. broke both bars. In *Experiments 10, 11, and 12*, 1120 lbs. at rest showed deflections from $\cdot 95$ to 1·17 inch, and a velocity of 29 feet per second, or nearly 20 miles per hour, increased them from 1·80 to 2·54 inches. The breaking-weights varied from 1204 to 1240 lbs. at the same velocity. and the greatest observed deflections from 1·80 to 3·36 inches. In *Experiments 13, 14, and 15*, the velocity was increased to 33 feet per second, or about $22\frac{1}{2}$ miles per hour, the statical deflections being from $\cdot 81$ to 1·30 inch, the breaking-loads from 1148 to 1288 lbs., and the last observed deflections from 2·67 to 3·65 inches. In *Experiments 16, 17, and 18*, the velocity was increased to 36 feet per second, and the greatest breaking-weight was 1204 lbs., the maximum observed deflection being 2·31 inches.

The *Second Series* comprised 15 experiments upon bars 9 feet long between the supports, 1 inch broad, and 3 inches deep. The breaking-weights at rest on the centre varied from 4126 to 4388 lbs., the maximum central deflection being 2·71 inches. With a velocity of 16 feet per second, the greatest breaking-weight was 3496 lbs., and deflection 2·70 inches. A velocity of 29 feet per second reduced the breaking-weight to 3167 lbs.; 36 feet per second reduced it to 2468 lbs., greatest deflection 2·08 inches. A velocity of 43 feet per second reduced the greatest breaking-weight to 2242 lbs., deflection 1·87 inch. From these results, it appears that a small load moving at a great velocity breaks a bar before it has suffered the whole of the deflection which a greater load produces, moving at a less velocity.

(To be continued.)

An elementary treatise on Statics, from the French of Gaspard Monge. By WOODS BAKER, A. M. E. C. & J. Biddle, Phil. 1850.

A work of this character has long been needed in our country. The majority of our mechanics are deterred from an investigation of the laws of matter, by reason of the abstruse forms under which these laws are exhibited for their study, and content themselves for the most part with practical and descriptive details. The consequence is, that much is undertaken which is inconsistent with the laws of nature, and failure is the inevitable result.

The book before us, however, requires but a knowledge of the elements of Geometry to be read without difficulty, and studied with profit.

To the mechanic who may be prevented a more extended knowledge of mathematics, it will prove invaluable; while to the student and engineer who contemplate mastering the analysis, without which a profound knowledge of Statics cannot be obtained, will find it a convenient stepping stone—the fame of its author being an ample guarantee for the correctness of its principles.

PATENTS.

List of Patents (with claims annexed), which issued from the United States Patent Office from the 21st day of January, 1851, to the 18th February, 1851, both inclusive.

No. 7907. Ambrose W. Thompson of Philadelphia, Pa., for improved Propeller. January 21. "What I claim as my invention is a propeller constructed as herein described, in such manner that any one of its blades, in any line drawn either parallel or perpendicular to its entering edge, shall have the curvature of a parabola produced as herein set forth." [The object of the patentee, as stated by himself, is to remedy the following alleged defect in screw propellers, viz., "that they expend a large proportion of the power employed in driving them in imparting a useless lateral movement to the water;" and he proposes "to increase the efficiency of these instruments by lessening this defect;" and the means by which he lessens this alleged defect "consist in constructing each blade of a propeller of such form that any section of it either parallel with or at right angles to the entering edge of the blade, shall be a parabolic curve." In plain English he pro-

poses a dishing blade. It would be well if people, before taking out patents for improvements of various alleged defects in existing contrivances, would ascertain whether those alleged were real defects. Had this rule been acted upon in the above case, it would have saved the patentee his fees, for this alleged defect in the regular screw propeller *does not exist*. There is no loss of efficiency by the lateral movement imparted to the water, nor is there in function of form, any loss of labor by the screw propeller, and the friction of the blade on the water apart, there is no choice in the propelling efficiency of one angle of blade over another, provided the projection of its surface at right angles to the keel be the same. As far as that friction is concerned, the angle of 45° gives the least. Furthermore the dished blade does not in any manner affect the action of the propeller, for by the numerous experiments of Bourgeois made by order of the French government, on screws of this kind, years ago, it was found that the propelling efficiency of the blade was precisely the same, whether it propelled by the dished (concave) or convex side. The alleged improvement is founded wholly on a fallacy.]

No. 7908. Jacob Scheitlin of Louisville, Ky., for improvement in Brick Presses. Jan. 21. "What I claim as new, in combination with the clay ducts and alternating carriage of moulds, the rods with their knives (for the purpose of cutting off and forcing into the moulds the regular quantity of clay), and sliding plate or gate for the purpose of opening and closing the communication between the clay ducts and moulds. 2d, I claim the arrangement of the pins, connecting rods, and standard, with its arm, for the purpose of removing the brick, after it is raised from the moulds, when the same are operated by means of the cranks, as herein described and shown."

No. 7909. George H. Thatcher of Albany, N. Y., for improvement in Stoves. Jan. 21. "I do not claim the device of sliding doors between parallel jambs or plates for the purpose of concealing the same. But what I do claim as new is the providing of the sliding doors, with flanges, on their vertical edges, the rear flange serving the purpose of hinges, in opening and closing the same; and also serving to form air-tight joints, when the doors are closed. And the front flanges serving, in connection with the projecting ends of the side plates, to relieve the appearance of a joint, when the doors are opened, as before described. I also claim the providing of the side plates, with projecting front plates, for the purpose of forming fronts to the spaces into which the doors are slid, when open, to conceal the same; and in connection with the rear flanges, to form the hinges of the doors, when closing the same; and also to conceal a portion of the front flanges, when the doors are opened and slid back, as described."

No. 7910. Edward T. Parker, of Berkley, Ala., for Improvement in Convertible Plow

Stock. Jan. 21. "What I claim as my invention is, so constructing a sub-soil plow, with removable mould board and cutter, in combination with the tri-pronged cultivating teeth, that the same stock may be used either for a sub-soil plow, or common plowing and cultivating the land, as herein set forth."

No. 7911. Charles Starr, of New-York, N. Y., for Improvements in Tools for Embossing Backs of Books. Jan. 21. "I do not claim forming various devices, by gluing or seenering loose or detached tools to a surface, as that is common; but what I do claim as my invention, is forming circular embossing, gilding or lettering tools, of any required pattern, for embossing, gilding and lettering book covers, by having a case, or hollow metal cylinder, fitting on a roller, and having an opening, or openings, in it, of any required form, for a panel, or other border; the part of the periphery of the roller within the opening or openings in the case, having any required number of small tools, of any suitable form or pattern, secured to it, the surfaces of the said tools standing even with the outer face of the case or cylinder, or by the employment of any number of tools, consisting of parts of a hollow cylinder, secured to a solid cylinder, substantially in the manner herein described."

No. 7912. A. A. Wilder, of Detroit, Mich., for Improved Lee-way Indicator. Jan. 21. "*What I claim as my invention, is, hanging the vane loose at the bottom of the rod, which carries or communicates with the pointer, and holding it either in position for operation, or secure within the vessel, above the bottom of the keel, by means of a spring or its equivalent, operating substantially as herein shown, and for the purposes herein set forth.*"

No. 7913. Daniel Wilson, Jr., of North Chelmsford, Mass., Assignor to D. Wilson, Jr. & H. H. Bird, of same place, for Horse-shoe-nail Machine. Jan. 21. "What, therefore, I claim is, the simple combination of the punch, the slotted beddie, the heading die, the header slide, discharging orifice and header, as arranged, constructed and made to operate together, substantially as specified, or in other words, their arrangement and construction essentially as explained, whereby they are made to separate the nail blank from the rolled plate, to move it downwards upon the header slide, to cause the header slide to advance in the mean time, to hold the nail blank by means of the punch and header slide, to cause the header slide to slide underneath the nail while it is so held, to carry the header against the nail and head it, to cause the header slide to retract or move backwards far enough to carry or move the discharging orifice directly under the nail, and so that the nail may be forced down into or through such orifice by the further depression of the punch, which next takes place, and finally to elevate the said punch to its first or highest position."

No. 7914. Elihu Smith, of Albany, N. Y., for Improvement in Stoves. Jan. 28. "What I claim as my invention is, the combination of

a transparent water vessel, with mica covered, or other transparent openings in the top of a stove plate, and a mirror placed upon a stove top, as herein represented and described."

No. 7915. Francis N. Still, of New-York, N. Y., for Improvements in Metal or Second Patterns for Castings. Jan. 23, 1851. "WHAT I CLAIM as my invention is, preparing second patterns by moulding metal patterns in two-part moulds, and then separating the two parts of the mould, the pattern being left in the sand, to cast a plate fitted to the metal pattern so moulded, as specified, so that the pattern can be attached to the plate, and the two be used in moulding, to produce castings, substantially as described."

No. 7916. Moses L. Knapp, of Painesville, Ohio, for Improvement in Abdominal Supporters. Jan. 28. "Having described the construction and also the operation of my improvement, what I claim as my invention is, the construction of hip springs with split or divided ends, forming elongations of the same strip of steel, the front prongs having slots and pivot holes, and the back prongs having two or more graduating pivot holes, to be used in combination with the adjusting screw and pivot screws, as herein substantially set forth."

No. 7917. James Hanley, of New-York, N. Y., for Swivel-nibbed Key. Jan. 28. "I therefore claim as my invention, the making the exposed ends of keys in such a manner that they may revolve freely upon the other parts of the key, substantially in the manner and for the purposes described."

No. 7918. William Fields, Jr., of Providence, R. I., for Improvement in the Hydraulic Ram. Jan. 28. "I claim as my invention and improvement, the hinge valve, opening upwardly and inwardly, at or near the upper end of the inclined plane or drive-pipe of the Hydraulic Ram; said valve being placed in a box made of brass or any other suitable materials, which valve, by closing, on the reaction of the water in the drive-pipe, prevents the said reaction from distributing the water in the spring or reservoir. The box of said valve is bolted to the drive-pipe, as represented in the annexed drawing, and said valve may be a hinge-valve, or any other suitable valve."

No. 7919. Newell Willys, of South Glastonbury, Conn., for Improvement in Drawing Regulators for Spinning Machines. Jan. 28. "What I claim as my invention is, the arrangement of the trumpet, as herein described, in connection with the system of weighted levers, escapement and reversed cone pulleys, whereby the force required to remove the trumpet is made to vary under different circumstances to a sufficient extent to prevent over-sensitiveness in the mechanism which changes the relative speed of the drawing rolls, to inequalities in the slivers, while at the same time little force is required to effect such changes, thus proportioning the draw more nearly than heretofore to the quantity of fibre in the sliver, and thereby

rendering the latter of more uniform diameter and density."

No. 7920. Alfred Hathaway, of Boston, Mass., for Improvement in Pens for Ruling Paper. Jan. 28. "Whatever may be the number of thicknesses of metal of which the back bar and pens are composed, my improvement, and what I claim, consists in not only making the upper one longer than the others, but in making it the marking part, and soldering the next one below it to it as specified. Such improved mode of making the pen or pens, I claim as my invention, and whether the plates of metal placed upon one another be of different metals or of different thicknesses of metal, as described. And I also claim the improvement in the construction of the back bar, the same consisting in making it with a slit or opening, between any two pens, and extending nearly or quite up to the vertex of the angle or bend of the bar, as specified, the same producing the advantage above mentioned. And when the pen is composed of more than two thicknesses of metal, I claim the improvement by which one single soldering of the upper and lower parts together suffices to bind or keep all the parts together or in place; the said improvement consisting in making the lowest thickness of metal longer than any of the others, except the first or upper and marking one, as described. And I also claim the method of making the pens or back bar, as shown in figures, when the same are composed of two different thicknesses of metal, or of two plates of different metals; the said improvement consisting in making the lower plate to inclose or lap over the one or others above it, and thus make the back bar of one more thickness of metal than the pens are composed of. And I also claim to make the different thicknesses of the pen of different metals, as specified."

No. 7921. Delamar Kinnear, of Circleville, Ohio, for improvement in Lard Lamps. Feb. 4. "I disclaim the invention of every part of the lamp, except the angular chambers, or grooves above the reservoir, on either side of the wick tubes, for preventing the spilling, or waste of the oil, when the stem of the lamp is held in a horizontal or inclined position; and also the dovetailed slide, and the aforesaid angular channels, or grooves. I claim as my invention, in combination with a lamp of the peculiar form and construction represented in the annexed drawings, or other form substantially the same—said channels, or grooves, serving also to receive and hold the sliding cover, used for closing the supply opening, instead of the ordinary screw cap;—and in combination with the aforesaid angular channels. I also claim the said sliding cover, when made with correspondingly shaped sides to fit and move in said channels, all as herein described and represented."

No. 7922. William Mt. Storm, of Troy, N. Y., for improved method of obtaining motive power, called *Aërogen Justo-motive*. Feb. 4. "What I claim is, actuating an Engine, such as are now usually driven by

steam, or of any convenient form, by means of the combustion, allied to an explosion, of a measured or detailed quantity of a charcoal (or other solid carbonaceous fuel, similar in nature and of like effect), in a measured quantity of highly compressed air (or oxygen), said combustion being effected in a vessel, which at that time is not in connection, either with the reservoir or main source of compressed air, or with that of the charcoal; and the gases resulting from each separate and distinct explosion, being allowed to act on the pistons, or their equivalents, before the other charges are introduced into the exploding or combustion vessel; the whole operation being effected through the agency of apparatus, in nature, substantially such as are herein specified; or apparatus that shall effect the whole operation, in the manner claimed. I also claim, in actuating an engine, as just claimed, using the combustible in a granulated or pulverized form, for the purposes and various reasons made known." [This is nothing more than a plan of using expanded air or other fixed gases, expanded by heat; the novelty (if it be novel), consists in presenting the carbon in a *granulated* or finely divided state to atmospheric air under a *compression* of 3 or 4 atmospheres and firing the carbon by electricity. The inventor states that by using compressed air, he attains so sudden and intense a combustion as to closely resemble an explosion. Now, it has been proved by numerous experiments that no advantage attends the use of compressed air for combustion, for, although by compression the quantity of oxygen (supporter of combustion) is increased in a given space; yet the diluent, nitrogen, is also increased in an equal proportion, and the combustion of the carbon remains the same, considered either with regard to intensity or economy. A more vivid and intense combustion could only be obtained by substituting pure oxygen for atmospheric air, yet even this would not remove the fallacy on which this invention is founded, and which infests all plans for the use of the fixed airs expanded by heat, for a motive power; viz., the vastly inferior economy in the use of fuel for the expansion of fixed airs, over its use for the production of steam from water; and which may be popularly illustrated as follows, viz: the application of 1000 degrees of heat to a fixed air,—say atmospheric air,—will expand its bulk three, and give it twice the atmospheric pressure, while the application of the same number of degrees of heat, will convert a given bulk of water into steam, expanding it 1700 times at the pressure of the atmosphere, or 850 times having double the atmospheric pressure].

No. 7923. Backus A. Beardsley of Waterville, N. Y., for improvement in Cooking Stoves. Feb. 4. "What I claim as my invention, is the construction of the adjustable and sliding partition by which the draft of the stove and the distribution of the heated air, under the bottom of the lower oven, is varied and controlled at

pleasure, adjusting the same to the particular place and circumstances of each stone."

No. 7924. Thomas W. Jones, of Philomath, Pa., for improvement in Machines for preparing Hides. Feb. 4. "What I claim as my invention is, the method of consolidating and smoothing leather, by drawing it, with a continuous motion, beneath a series of stampers, which alternately rise, fall, and rest upon its surface, a portion of the stampers being at all times in contact with the leather, so that the smoothing of its surface is constantly going on, simultaneously, with the consolidation, by the blows of the falling stampers."

No. 7925. Enoch Burt, of Mauchester, Conn., for improvements in Fancy Check Power Looms. Feb. 4. "I claim as my invention, the connecting a series of shuttle boxes, by joints at their lower corners, or attaching them to a flat jointed chain, and connecting their extremities, so as to form an endless chain of boxes, and bringing them into a parallelogramic figure, by means of two square heads, of a size to fit the space between the joints of the boxes, or the cam, and hung on journals, one on the end of the race beam, and the other on the sword of the lay, substantially as heretofore described. 2d, I claim the combination of the irregular worm, the two sets of double rectangular levers, the connecting bars, and the vertical notched levers, on which the bars operate the pin band knees, and the wires connecting the knees and vertical notched levers, through which the notched levers are moved forward and backward to embrace the bars, giving them, with the heddles, an upward and downward movement, in any irregular manner desired, substantially as described in the specifications, constituting a new and advantageous modus operandi of forming a variegated shed."

No. 7926. Henry G. Thompson, of New-York, N. Y., for improved method of adjusting the packing of Rotary Engines. Feb. 4. "What I claim as my invention is, the method, substantially as above described, of regulating the packing ring interposed between the steam wheel and head of the cylinder, or outer casing, of rotary steam engines, by combining with the said packing ring, a series of segment wedges, operated simultaneously, in manner substantially described."

No. 7927. Leonard Goodrich, of New-York, N. Y., for improved Ship's Light. Feb. 4. "I claim hanging the screwed socket or frame, containing the glass, so as to turn freely within a frame, which swings on a hinge, provided with a slot, or its equivalent, whereby the socket can be screwed into or unscrewed from the fixed socket, and when unscrewed, be swung back, substantially as herein described."

No. 7928. Sidney S. Hurlbut, of Racine, Wis., for improvement in Grain Harvesters. Feb. 4. "Having thus described my improved Reaping Machine, I first claim combining with a reaping machine, a self-acting

weighing apparatus, for weighing the grain into any required quantity to form sheaves or bundles of a uniform weight, as described, and depositing the same upon the ground, in readiness to be tied, whilst the reaping machine is drawn forward and cuts the grain; the said weighing apparatus being made adjustable, so as to increase or diminish the size of the bundles at pleasure. And this I claim, whether the weighing apparatus be made and arranged as described, or in any other way which is substantially the same; or whether combined with the aforesaid reaping machine, or any other of a similar character. Second, I likewise claim the combination of the bent holders, with the inclined, endless conveyor, for holding the grain thereupon, whilst conveying it to the weighing and depositing apparatus, as aforesaid."

No. 7929. Chas. Schofield & Geo. I. Johnson, of Albion, Ills., for improved Scraper. Feb. 11. "We claim as new the combination and arrangement of the coop, standard, beam, arm, and handles, in such manner, that, when the scoop is tripped, it will revolve sufficiently far to allow the earth to slide off, and then remain in such position, as that the operator, by a slight movement of the handles, can level down the earth with the scoop, and without the aid of another hand, or another scraper, as herein described."

No. 7930. Samuel & Morton Pennock, of Kennet Square, Pa., for seeding apparatus of a Seed Planter. Feb. 11. "What we claim as our invention is, the employment of the ring, or cylinder, having projections on its periphery, in combination with the notched and toothed cylindrical gauge-caps, constructed, arranged, and operated, substantially in the manner herein set forth, for increasing and diminishing the size and number of the distributing receptacles. We likewise claim the combination of the helical spring, screw shaft, flanged nut, and clamp nut, with the notched and toothed cylindrical gauge caps, to which the ends of the spring are attached, for turning the gauge cap, in order to change the relationship of the teeth or projections of one of the caps, with the teeth or projections on the adjacent cap, for enlarging the distributing receptacles, as described in the foregoing specification. We also claim the combination of the screw shaft, clutch nut, clutch washer, and clamp nut, with the toothed cylinder caps, for enlarging or diminishing the distributing receptacles, as described. We likewise claim the modifications of the distributing apparatus, in their simplified forms."

No. 7931. Wm. O. Grover, of Boston, Mass., and Wm. C. Baker, of Roxbury, Mass., for improvement in Sewing Machines. Feb. 11. "What we claim as our invention is, the use of two needles, operating alternately, one working vertically and the other horizontally, uniting two pieces of cloth, or forming the seam, by means of the double loop stitch."

No. 7932. John Osborn, of Hamden, Conn., for improvements in operating the waste-gate

in Hydraulic Rams. Feb. 11. "What I claim as my invention is, the use of the regulating slide, and nut, or other similar arrangement, in combination with levers, wires, springs, rods, weights, or other devices for adjusting the "waste" valve, and operated on, and in combination with a float at the spring or source, which float rises and falls with the water. I also claim the use of the hammer, resting or falling on a springing piece for opening the "waste" valve, or starting the hydraulic ram, and worked as described, or in any other similar manner."

No. 7933. Joseph E. Ware, of St. Louis, Mo., for method of securing ranges of short plank in pavements. Feb. 11. "What I claim as my invention is, the method above described, of securing ranges of short pieces of the planking of a street or road, in longitudinal lines over water or gas pipes, by means of screws or keys with staples aided by the double bevel of the short planks and the ends of the permanent interval planks, securely holding and permitting of the easy removal of such short pieces."

No. 7934. E. H. Ashcroft, of Boston, Mass., for insulated Fusible Plug for steam boilers. Feb. 18. "What I claim as my invention is, the arrangement herein described, for surrounding a fusible plug and its case, by a stratum of air, in such manner that the plug shall promptly melt and give warning after the water gets low in the boiler, but before the boiler-plate, to which the apparatus is applied, is left bare of water. I also claim the arrangement of the stopper and plug case for stopping the escape of steam, to admit of the replacement of the fusible plug, without blowing off the steam or water from the boiler, after the plug has melted. I likewise claim the method of preventing the waste of the metal of the plug, after it has melted by supporting it in a closed socket, the lower unoccupied part of which is of sufficient capacity to receive and retain the metal, when melted, and to allow the steam to pass over it to escape." [The patentee claims only the arrangement for applying, (not the idea itself, of applying,) a plug made of some fusible alloy, (that is, of an alloy, which will melt at a low degree of temperature,) to the interior of steam boilers. The object to be attained is simply this, suppose a boiler to be intended to be operated with steam of a temperature of 250 degrees, and suppose a plug or disk of an alloy that will melt at 260 degrees be inserted in any part of the interior, just over the fire surface, and put in communication with one end of the lever of an ordinary safety valve, the opposite end being weighted. Now when steam of 260 degrees temperature is generated in the boiler, either surcharged or from water, the alloy will melt from around the rod communicating between it and the safety valve, which valve will then be opened by the weight on the opposite end of the lever, and an escape formed for the steam. It is obvious that the only use of such a contrivance is for the case of surcharged steam,

that is of steam having a temperature higher than what is due to its pressure. This occurs in steam boilers by the water being allowed to fall below the fire surface, which then imparts its heat direct to the steam, expanding it only 1-480th for each degree of Fahrenheit. The heat being taken up by the steam but slowly from the fire surface, the latter soon becomes red hot, and the metal is either permanently injured by the burning, or is so far weakened that it *collapses*. The ordinary safety valve in this state of the case would be useless, because the surcharged steam might have a less pressure than the valve is loaded at, and yet a temperature destructive to the material of the boiler. The great cause of apprehension however in such a case, is the imminent danger of an explosion, when from any cause, (either feeding additional water or lessening the pressure in the boiler by working off the steam through the engine faster than it is generated, &c.,) the water is brought up on the overheated surface, when steam is so copiously and suddenly generated that neither the engine nor safety valve can afford sufficient relief, and an explosion inevitably follows. In this view of the case it will be perceived that a *fusible plug is the very best means for causing an explosion*, because as soon as it is melted by the heat of the water denuded fire surface, it opens a safety valve, the opening of which valve relieving the pressure in the boiler sets the water to foaming, thereby raising the water level and bringing it up on the overheated metal, the sudden and copious generation of steam that follows, not having sufficient openings to discharge it in time, bursts the boiler. The great majority of boiler explosions are probably due to this cause alone.

The whole subject of fusible plugs was ably experimented on some years ago by Walter R. Johnson, by order of the Navy Department, and their use, though once commanded by a royal ordinance in France, has long since been discontinued in that and all other countries; and the proposition for its application could only be made by a person wholly ignorant of the investigations of others on the subject.]

No. 7935. Thomas Chapion, of Philadelphia, Pa., for improved annular Steam Boiler. Feb. 18. "What I claim as new, and of my invention, is 1st, the employment of the tapered rings for closing the ends of any of the water spaces of the concentric boilers, in the manner set forth. 2d, I also claim connecting the lower parts of the annular water spaces, each to each from the upper and inner to the lower and outer one, by metallic rings or collars—thus giving free ebullition, assisting evaporation, and allowing the dirt to settle down into the blow-pipe, from whence it may be blown out;—the aforesaid rings, or collars, bracing the boilers, as well as forming the connection between the eyeliners."

No. 7936. Isaac H. Garretson, of Clay, Iowa, for improvements in Hand-Looms. Feb. 18. "What I claim as my invention is

the device, consisting substantially of the tappet shaft, with its ring block and ratchet, together with the connecting cord, weight and marches, whereby the heddles are raised and depressed in the proper order, to form the shed by the movement of the lay, substantially as herein set forth. I likewise claim the device, consisting substantially of the levers, with the breast-beam cords and picker-stick cords, whereby the picker-sticks are moved to drive the shuttle by the movement of the lay."

No. 7937. Philo S. Beers, of Hamden, Conn., for improvement in Machines for Turning Irregular Forms. Feb. 18. "What I claim as my invention are, 1st, the three cutter cylinders (with cutters arranged as within described), in combination with the sliding frame, compound cams and cam-rails, constructed and arranged, substantially, in the manner and for the purpose herein described. 2d, I claim the combination of the compound cams and cam-rails with the sliding frame and devices (within described), for holding and revolving the timber material, whereby such vertical motion is produced in the latter, while being subjected to the action of revolving or vibrating cutters, as to reduce the timber to the required form."

No. 7938. John A. Fry, of Edinburg, Va., for improvements in Tools for Tonguing, Jointing, and Rebating. Feb. 18. "What I claim as my invention is, so making a jointing, tonguing, and rebating plane, that the jointing and tonguing of a board, while resting on its edge, and also the jointing and rebating of it while it lies on its flat side, may all be performed with one planing tool, in the manner, substantially, as herein described, and for the purposes herein set forth. I also claim making the tonguing hand-plane in such a manner as to enable the workman to make therewith tongues of various thicknesses, substantially, in the manner herein set forth, whereby I prevent the necessity of providing different tools to tongue planks of different thicknesses. I also claim, in combination with a divided body or plane stock, the two cutters, having each a cross-cutting and side-cutting edge, and the means, substantially as herein described, for adjusting the distance apart of the two cutters and bodies, whereby the plane is made capable of dressing the sides of a tongue to any desired thickness, and at the same time to cut the shoulders, as herein specified. I also claim, in combination with the gauge, the use of the body and the cross edge of the cutter to constitute a jointer, to straighten the edge of a board, preparatory to tonguing it, and while resting on its edge, in a situation to receive the tonguing. I also claim the gauge, in combination with the notch, and the side edge of the cutter acting (as herein described) as a jointing plane, to straighten the edge of a board or plank, resting on its flat side, in a position to have a rebate cut, in the manner, substantially, as herein set forth."

No. 7939. Charles T. Judkins, of Lowell, Mass., for improvement in Weavers' Heddles.

Ante-dated Dec. 10, 1849. Feb. 18. "I claim as my invention, covering, coating, or lining the loops or eyes in heddles or harness with metal."

No. 7940. William Post, of Flushing, N. Y., for improved Attachment for Opening and Closing Doors or Shutters. Feb. 18. "What I claim as my invention is, the use of swinging attachments or jibs, for moving sliding doors or shutters."

No. 7941. Philip Rhodes, jr., of Pittsburg, Pa., for improved Snatch-block. Feb. 18. "What I claim as my invention is, the closing up of the opening in the side of ships' snatch-block, by means of a gate, arranged and operating, as herein set forth, by which I am enabled to make the block shorter and more compact than it has heretofore been made. I also claim the securing the pulley axle in its place, without the aid of screw and nut, or rivet heads, and in such a manner that it can be readily removed, by means of the combination of the said pulley axle with the inclosing strap and the gate strap."

No. 7942. Daniel H. Southworth, of New-York, N. Y., for improvement in Planing Machines. Feb. 18. "I claim, 1st, the use of circularly grooved rollers in front of the cutters, to divide and cut the unplanned surface of the board into narrow longitudinal strips, whereby the outer shavings are taken off in narrow strings or threads, in the manner and for the purposes herein set forth. 2d, I do not claim simply the arrangement of the plane stocks, with their cutters upon the travelling-frame in such order that one gang or set of cutters will plane one plank by their movement in one direction, and another gang of cutters plane another plank, by their movement in the opposite direction, and remove the first plank planed from the bed, but this I claim only when these are used in connection with the circular groove serving roller, as within described."

No. 7943. Isaac Straub, of Cincinnati, Ohio, for improvement in Saw Mills. Feb. 18. "What I claim as my invention, is the method of imparting a rocking or curved motion to the saw, and of straining the same by mechanical devices."

No. 7944. James D. Willoughby, of Scotland, Pa., for improvement in apparatus for raising and carrying water. Feb. 18. "What I claim as my invention, is the double draught cord, so arranged and connected with the car windlass, that it effects the twofold purpose of propelling the carriage to and fro, and of turning the car windlass, to unwind and wind up the bucket cord, thus insuring the descent of the bucket into the well."

Reissues.

No. 189. Hiram Hibbard, of Henrietta, N. Y., Assor. to William W. Reid, of Rochester, N. Y., for improvement in tanning leather by Tannin and Acids. (Patented Oct. 16, 1849, reissued Feb. 11, 1851.) "1st. I claim the process of removing hair and wool from hides and skins, and of 'liming' them,

so called, preparatory to tanning, by the use of a composition of lime, wood ashes, or potash, and of salt, called composition No. 1, in the manner above described. I also claim the use of a composition of lime and wood ashes, or potash, *without the salt*, but I do not claim either of these materials separately by itself. 2d. I claim the process of tanning hides and skins, by the use of any kind of tannin, in combination either with the *muratic acid of commerce*, or with *muratic acid*, generated by a mixture of sulphuric acid and salt in water with the tannin, in the manner substantially as above described."

Designs.

No. 344. Joseph G. Lamb, of Cincinnati, Ohio, for Design for Stoves. Jan. 21. "What I claim as new and my invention, is the arrangement and combination of the shapes, figures, ornaments, flutes and mouldings in the specified design for coal-heating stoves."

No. 345. S. W. Gibbs, of Albany, N. Y., Assor. to North, Harrison & Co., of Philadelphia, Pa. Ante-dated Dec. 31, 1850, dated Jan. 21, 1851. "What I claim as my invention, is the Ornamental Design for a Stove, as represented."

No. 346. Samuel W. Gibbs, of Albany, N. Y., Assor., to Jagger, Treadwell & Perry, of Albany, N. Y., for Design for Cooking Stoves. Jan. 21. "What I claim as my production, is the combination and arrangement of ornamental figures and forms, as making an ornamental design for a cooking stove."

No. 347. Conrad Harris & Paul W. Zoiner, of Cincinnati, Ohio, for Design for Stoves. Jan. 23. "What we claim as our invention, is the combination and arrangement of scrolls, foliage, figures and mouldings into an ornamental design for coal and wood parlor stoves, to be known and called Harris & Zoiner's Patent Coal and Wood Parlor Stoves."

No. 348. Samuel A. House, of Mechanicsville, N. Y., for Design for Cooking Stoves. Feb. 4. "What I claim as new, is the design of a cook stove."

No. 349. Samuel A. House, of Mechanicsville, N. Y., for Design for Parlor Stoves. "What I claim as new, is the design of a stove plate."

No. 350. Edward J. Delany, of Philadelphia, Pa., Assor. to Heins & Adamson, of Philadelphia, Pa., for Design for Umbrella Stands. Feb. 18. "What I claim as new, is the peculiar ornamental design, or figure."

List of English Patents issued from Nov. 30 to Dec. 26, 1850.

John Platt, of Oldham, Lancaster, engineer, for certain improvements in machinery or apparatus for spinning and doubling cotton, and weaving cotton, flax, and other fibrous substances. December 2; six months.

Thomas Watson, of Rochdale, Lancaster, hat manufacturer, for improvements in the manufacture

of hat plush, and also in machinery or apparatus employed in such manufacture. December 2; six months.

Richard Shiers, of Oldham, Lancaster, manufacturer, and James Heginbottom, of the same place, manager, for improvements in the manufacture of textile fabrics. December 2; six months.

Julian Bernard, of Green-street, Grosvenor-square, gentleman, and Jean Baptiste Durenille, of 30, Cite de l'Etoile, Thermes, France, for improvements in the manufacture or production of boots and shoes, and in the materials and machinery or apparatus to be employed therein. December 4; six months.

Benjamin Hinley, of Birmingham, brassfounder, for improvements in the manufacture of castors. December 5; six months.

Joseph Alexander Franklinsky, of Stanhope-place, Middlesex, gentleman, for improvements in public carriages for the conveyance of passengers. December 5; six months.

Ewald Riepe, of Finsbury-square, London, merchant, for certain improvements in refining steel. December 5; six months.

Henry Walker Wood, of Briton Ferry, near Neath, Glamorganshire, gentleman, for improvements in the manufacture of fuel. December 7; six months.

Samuel Raynor, of Bernier's-street, Oxford-street, Middlesex, artist, for improvements in paving. December 7; six months.

Archibald Turner, of Leicester, manufacturer, for improvements in applying heat for generating steam for motive power and for other purposes, and in generating heat, and in heating and evaporating fluids. December 7; six months.

James Thompson Wilson, of Stratford-le-Bow, Middlesex, chemist, for improvements in the manufacture of alum, and in obtaining ammonia. December 7; six months.

Francis Papps, of Camberwell, chemist, for improvements in metallic and other bedsteads, mattresses, and curtain rods, and in the coating or covering of bedsteads, and other articles wholly or in part composed of metal. December 7; six months.

Alexander Mein, of Glasgow, accountant, for certain improvements in treating the fleeces of sheep when on the animals. (Being a communication.) December 7; six months.

John Mortimer, of Hanover-square, Middlesex, esquire, for improvements in the magnetic needle and mariners' compasses. December 7; six months.

George Henry Voyex, of Acton-street, Middlesex, artist, for improvements in the manufacture of paper hangings. December 7; six months.

James Ward Hobbs, of Glasgow, engineer, for improvements in the construction of the permanent way of railways. December 7; six months.

John Everest, of Tonbridge, Kent, and George Osborne, of the same place, for certain improvements in commodos, and in fixed and portable water-closets. December 7; six months.

David Lloyd Williams, of Thornhill, Llanelli, Carnarthen, gentleman, for certain improvements in furnaces. December 7; six months.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in engines to be worked by steam or other power. December 7; six months.

Richard Archibald Brooman, Fleet-street, London, patent agent, for improvements in agricultural machines. (Being a communication.) December 7; six months.

Peter Wood, of the firm of Thomas Bury and Co., dyers, calenderers, and finishers, Adelphi Works, Salford, Lancaster, for improvements in figuring and ornamenting woven fabrics, and in machinery employed therein. December 11; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improvements in cutting and dressing stone. (Being a communication.) December 12; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improvements in the manufacture of iron hurdles or fences, and of certain other

articles in the construction of which wire-work is or may be employed. (Being a communication.) December 12; six months.

William Becket Johnson, of Manchester, Lancaster, manager, for certain improvements in steam engines and in apparatus for generating steam; such improvements in engines being wholly or in part applicable where other vapors or gases are used as the motive power. December 12; six months.

John Mason, of Rochdale, Lancaster, machine-maker, and George Collier, of Halifax, York, manager, for certain improvements in preparing cotton and other textile materials for spinning, and in tools or apparatus for making cards and other parts of such preparing machinery, and in engines for giving motion to the same, which engines are also applicable in other cases where motive power is required. December 12; six months.

Samuel Baxter, of Wapping, Middlesex, shipwright, for improvements in apparatus for lifting, and for facilitating the working or steering of ships. December 12; six months.

Thomas Hoskins Howels, of Amelia-row, Landport, Portsea, Hants, gunner, for improvements in gun-carriages. December 12; six months.

Joseph Bennett, of Deptford, Kent, engineer, for certain improvements in doors, window-shutters, and blinds. December 12; six months.

Edmund Morewood, of Enfield, Middlesex, gentleman, and George Rogers, of the same place, gentleman, for improvements in coating or covering metals. December 12; six months.

Jean Aime Marnais, of Lyons, for improvements in the manufacture of indigo. (Being a communication.) December 12; six months.

Joseph Baldwin and George Collier, both of Halifax, mechanics, for improvements in the manufacture of carpets and other fabrics. December 12; six months.

George Royce, of Fletland, Lincoln, miller, for improvements in grinding, dressing, and cleaning corn and seed. December 12; six months.

George Benjamin Thomeycroft, of Wolverhampton, Stafford, iron-master, for improvements in the manufacture of crank-axles. December 12; six months.

Charles Cowper, of Southampton-buildings, Chancery-lane, patent agent, for improvements in the manufacture of tiles. (Being a communication.) December 19; six months.

David Auld, of Glasgow, engineer, for certain improvements in steam engines, and in the working of steam boilers or generators, and in apparatus connected therewith. December 19; six months.

Sebastiano Botturi, of No 7, Place de la Bourse, Paris, civil engineer, for certain improvements in machinery and apparatus for elevating fluids, and in their application as a motive power. December 19; six months.

Adolphus Oliver Harris, of 11th Holborn, philosophical instrument maker, for improvements in barometers. (Being a communication.) December 19; six months.

George Henry Bachhoffner, of Grove-road, St. John's Wood, Middlesex, and Nathan Defries, of Grafton-street, Fitzroy-square, civil engineer, for improvements in obtaining light and heat, and in apparatus connected therewith. December 19; six months.

Edward D'Orville, of Manchester, merchant, and John Partington, of Withen Hall, near Rochdale, in the same county, bleacher, for certain improvements in finishing thread or yarn. December 19; six months.

Henry Mortlock Ommamney, of Chester, Esq., for certain improvements in the manufacture of steel. December 19; six months.

John George Taylor, of Great St. Thomas Apostle, London, merchant, for improvements in the manufacture of dress and other pins, and other dress fastenings and ornaments. December 19; six months.

William Henry Green, Basinghall-street, London, gentleman, for improvements in the preparation of

peat and other ligneous and carbonaceous substances, and in the conversion of some of the products derived thereby, and in the mode of their application to the preservation of substances liable to decomposition and destructive agencies, and which mode is also applicable to other products of a similar nature. (Being a communication.) December 19; six months.

Philip Nid, of Leicester-square, gentleman, for improvements in the manufacture of sugar, and in cutting and rasping vegetable substances. (Being a communication.) December 19; six months.

John Henry Pape, of Paris, for improvements in musical instruments. December 20; six months.

William Herbert Gossage, of Stock Prior, Worcester, chemist, for improvements in the concentration of sulphuric acid and certain other fluids; also in the use of a certain product or certain products sometimes obtained in manufacturing sulphuric acid and sulphurets. December 20; six months.

Richard Rodham, of Gateshead, Durham, practical chemist, and Edward Robert Hoblyn, of Stepney, Middlesex, gentleman, for improvements in machinery and apparatus for condensing and purifying smoke, gases, and other noxious vapors arising from fire-places and furnaces, or from chemical and other works, and in rendering the products resulting from such condensation and purification available for the manufacture of various colors. December 16; six months.

Edward Dunn, of New-York, but now residing at the London Coffee House, Ludgate Hill, London, master mariner, for an improved engine for producing motive power by the dilatation or expansion of certain fluids or gases caused by the application of caloric. December 26; six months.

William Hodgson Gratrix, of Salford, Lancaster, engineer, for certain improvements in the method of producing or manufacturing velvets or other piled fabrics. December 26; six months.

CORRESPONDENCE.

A correspondent asks—"Why, in the last number of the Magazine, do you call the engines represented as in use on the Upper Danube, *marine engines*?" We can answer as did Johnson, when asked by a lady why he had in his dictionary defined *pastern* as the *knee* of a horse,—"Ignorance, madam—sheer ignorance."

We owe an apology to "N. H." that his article in answer to "W." in the last number of the magazine, was not as conspicuously placed as the latter, nor as the rejoinder in the present number. This was one of those accidents which he will readily understand without further explanation.

"J. B. A." is referred to the article on R. R. Frogs &c. in the present number as furnishing all he will require. We can recommend to him *Mifflin on Railway Curves*, published in Philadelphia, as the best thing to our knowledge published on the subject.

"J. O. M." (Savannah.) His stand-pipe is yet incomplete. A notice was sent him, as we supposed, in the last number, in reference to it, but we find the printer omitted it.

All we can say is, that the lesson will be a good one to him, worth all it has cost him.

"S." The article on atmospheric pile-driving will appear in the next number.

APPLETONS'

Mechanics' Magazine and Engineers' Journal.

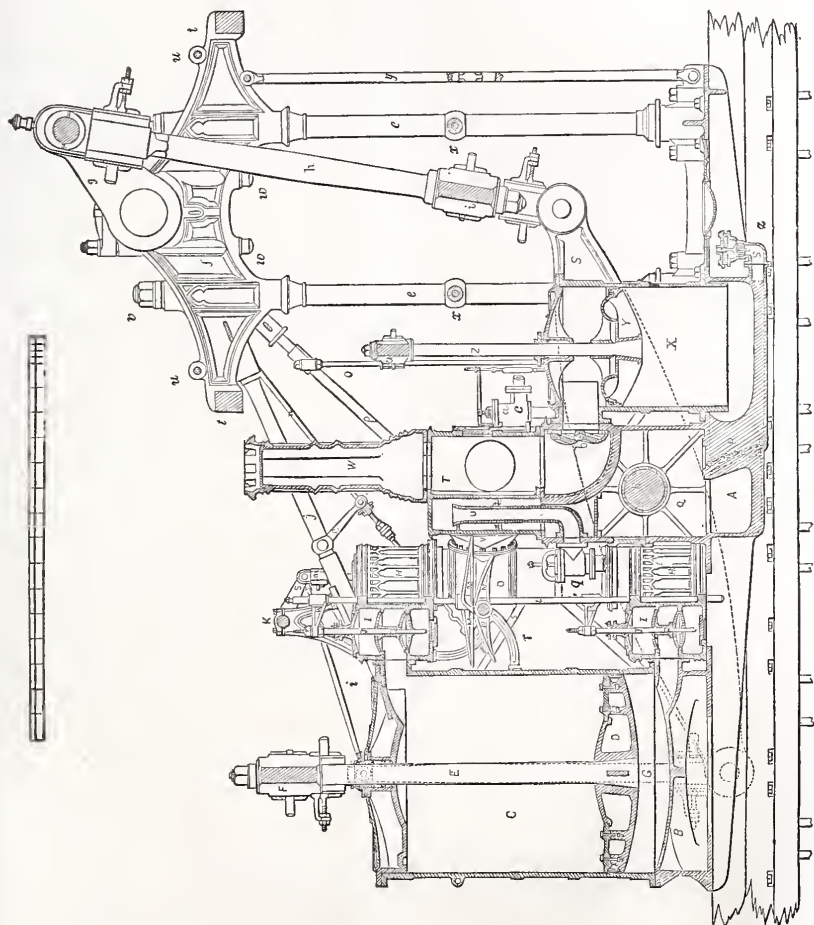
VOL. I.]

TUESDAY, APRIL 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 4.]

LONGITUDINAL SECTION AND PROJECTION OF ENGINE OF THE U. S.
MAIL STEAMER PACIFIC.



ENGINE OF THE UNITED STATES MAIL
STEAMER "PACIFIC."

For Appletons' Mechanics' Magazine and Engineers' Journal.

As a specimen of the Marine Engineering of this country, we take pleasure in commencing our number this month with a descriptive section of the Engine of the U. S. Mail Steamer Pacific, built for E. K. Collins & Co., at the Allaire Works, from the design of C. W. Copeland, Esq., whose reputation as a Mechanical Engineer, is second to none in this country.

Reference.

A, The bed-plate upon which the engine stands. B, The cylinder bottom cast upon the bed-plate, in which is the lower steam opening. C, Cylinder. D, Steam piston. E, Piston rod. F, Cylinder cross-head attached to the piston rod and also to the side levers by two side rods. G, Cylinder side rods. H, H, Upper and lower steam chests, in which are fitted valves for the induction and eduction of steam to and from the cylinder. I, I, Steam valves. J, J, Valve stems, on which are keyed the steam valves. K, Parallel motion shaft and standard. L, Lifting rods for lifting steam and exhaust valves, worked from an eccentric on the water wheel shaft. M, M, Steam toes keyed to the lifting rod. N, N, Feet for lifting rods, attached to the rock shaft. O, Steam and exhaust side pipes. P, Foot valves and seats. Q, Condenser cast upon bed plate. R, Side lever shaft passing through and firmly keyed to condenser. S, Side levers. T, Hot well. U, Injection pipe. V, Connection from exhaust pipe to condenser. W, Air column to receive the air arising from the waste water, thereby facilitating its discharge. X, Air pump. Y, Air pump piston. Z, Air pump rod. A, Air pump crosshead. B, Delivery valves and seats. D, Force pump chest. E, E, Pillow block columns keyed into sockets cast upon the bed-plate. F, Pillow blocks for water wheel shafts. G, Cranks. H, Main connecting rod connecting crosstail and crank pin. I, Crosstail attached to the side levers by two short links, also the main connecting rod. J, Main braces from pillow blocks to cylinder. K, Steam valve lifters keyed to the lifting rods. L, Parallel bar for parallel motion. M, Parallel motion connecting rod. N, Eccentric rod. O, Guide rod for air-pump crosshead. P,

Brace from pillow blocks to ped-plate. Q, Injection valve. R, Centre bearing for rock shaft. S, Brace from cylinder to bed-plate. T, T, Cross beams for pillow blocks. U, U, Studs and transverse braces. V, Nuts for screwing pillow blocks to columns. W, Bolts for holding down pillow block caps. X, X, Studs between columns and bolts running transversely through each set. Y, Braces from pillow blocks to bed-plates in the centre of each and between engines. Z, Shifting valve.

For the details of these Engines, see Appleton's Dictionary of Machines.

AUFHÄNGE MACHINE: OR SELF-ACTING
DRYING MACHINE.

Translated from the German, for Appletons' Mechanics' Magazine.

Most, if not all the machines used in the bleacheries and print-works of this country, for the hanging of cloth to undergo the process of drying, are hand-machines. We have therefore extracted from the "Allgemeine Maschinen Encyclopædie" the drawings and description of a self-acting hanging-machine which is in practical operation abroad, and which will, at least, be found suggestive of improvements in the machines at present in use here.

Fig. 1, a longitudinal section of a drying-house. Fig. 2, a cross-section of the same. Fig. 3, an enlarged section of the hanging-machine itself. Figs. 1, 2, on a small scale, show the position and arrangement of the machines with regard to the drying-house. A A, are the walls of the house. B B, the roof. C C, ventilators. D, steam-boiler. E E, steam-pipes for the heating and circulating of the air. F F, side timbers, supported by cast-iron brackets on the walls. H H, longitudinal timbers in the centre of the building supported by the posts I I. On F F and H H iron rails are spiked for the transit of the machine. K K, the hanging-bars from which the folds, K K, of wet cloth are suspended.

The hanging-machines, as shown more clearly in Fig. 3, consist of an iron-framed car, supported on the wheels A A, running on rails placed on the timbers F F and H H. It will be seen (Fig. 2) that there are two of these cars in the width of the building, which each admit

Fig. 1.

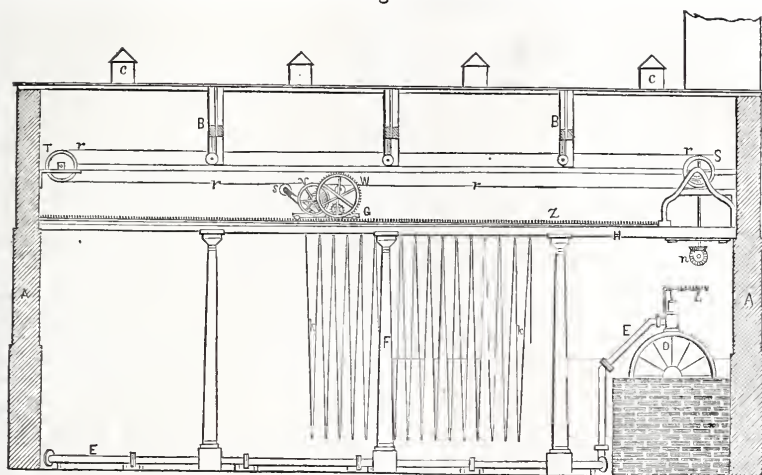


Fig. 2.

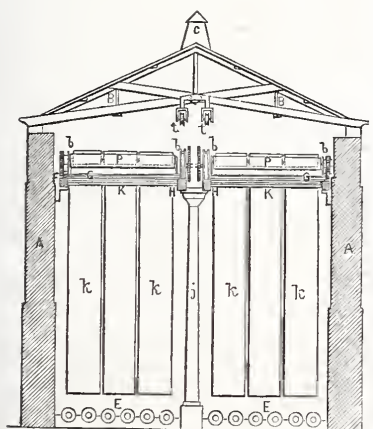
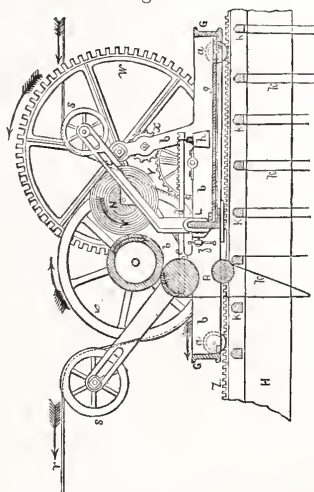


Fig. 3.



three breadths of cloth. The wet cloth is placed on the beams *NN*, whose gudgeons rest on the inclined planes of the frames *cc*. These frames are clamped to the cross-bars *I*, of the car-frame, by the screw *z*. This admits of alterations in the position of *cc*, to suit various widths of cloth. As the cloth on the beams *N* is continually in contact with the drums *PP*, any motion communicated to *P* is communicated to the cloth-

beam, and in either direction, according to the direction of the motion communicated. *qq* are other rolls or drums over which the cloth passes from the beams *NN*, and then falls perpendicularly in the spaces between the hanging-bars *KK*. The gudgeons of the rolls *qq* are supported at one extremity of the levers *dd*, whose fulcra are at *ee*, whilst the weights *hh* at the other extremity of the levers bring the rolls *qq* in contact with

the drums *P P*, and receive motion from *P P*.

It now remains to see how motion is communicated to *P P*, for the letting down or taking up of the cloth, and also for the movement of the car.

U is a bevel wheel on the extremity of a horizontal shaft, receiving its motion from the motor of the works. This bevel gives motion to an upright shaft, from which, by a combination of bevels sliding on this shaft, motion is communicated in either direction to the shaft of the pulleys *s s*, or the bevels may be entirely disengaged, and the revolution of *s* stopped. The engagement and disengagement is made as usual by a lever, which can be moved at any point on the line of track at which the workmen might happen to be. A leather strap, or endless band, extends the whole length of the building, passing over the pulleys *s s*, and the pulleys *t t*, at opposite ends of the building. Small pulleys *l l* take up the slack of the upper part of the belt. The lower portion of the belt, by means of the binders *s s*, on the machine, is made to rub on nearly half of the circumference of the pulley *v*, fastened to one extremity of the drum *P*, and by this, motion is communicated to *P*, and consequently to the cloth-beam *N*, and the cloth is let off or taken up, according to the direction of motion of the belt. To the shaft of the pulley *v* a pinion is attached, which gears into the spur-wheel *w*. A pinion attached to the shaft of *w* communicates motion to the spur *y*, through an intermediate *x*. The shaft of *y* extends the whole breadth of the car, and has a similar wheel to *y* at its other extremity. These two wheels gear into racks fastened to the timbers *F* and *H*, and, in this way, motion is communicated to the car, by the movement of the pulley *v*, or rather of the endless band. Small drums *R R*, fastened to the frame of the bottom of the car, and having small vertical play, retain the wet cloth on the hanging-bars, till the fold being formed is of sufficient weight to keep its position, and not be drawn back by the preceding fold. The edges of the hanging-bars are scarfed, so that the drums or rolls *R R* may readily pass over the bars, and still retain the cloth better and longer than if the edges were square.

The cloth beam *N* is not necessarily

to be placed in contact with *P* in letting off the cloth, but must be in taking up; in fact, the cloth in the first case may not be placed on a beam at all, but if more convenient may be laid in folds on a small platform made on the car.

On the working velocity of the Machine.

—The velocity of the machine will depend on the height of the drying house, or rather the lengths of the folds of cloth. It has been found in working that 6 feet of cloth is about the proper length of cloth to be let off per second; if, therefore, the length of the double fold be 30 feet, the car must be 5 seconds in passing from the centre of one hanging bar to the centre of another, a distance say of 8 inches. Let the diameter of the drum *P* be 10 inches, (circumference 31·41 inches,) then to let down 30 feet or 360 inches of cloth it must make 11·46 revolutions. The gear *y* is 11½ inches in diameter; then since 30 feet of cloth is let down for every 8 inches of the movement of the car, or 45 inches for every inch, therefore for every revolution of the gear *y* the car traverses 36·12 inches, and 1625·4 inches of cloth are let off. Now dividing 1625·4 by the circumference (31·41) of *P*, we have 51¾, say 52, for the number of revolutions to be made by *P* for one of *y*, which proportion is to be obtained by the combination of pinions and gears above mentioned. If now the pulley *v* be 2 feet diameter, or 6·28 feet in circumference, the velocity of the endless

band must be $\frac{6 \cdot 28 \times 11 \cdot 46}{5}$ or 14·4 feet per second.

A much simpler way of imparting motion to the car from the pulley *v* might be made by fixing in each extremity of the shaft of *v* and *P* endless screws, which working in horizontal spar gears would communicate motion to upright shafts, on the lower extremities of which small pinions fixed work into racks placed sideways on the beams *F* and *H*.

The workman who tends the machine has a seat on a small car attached behind the machine or large car; this permits him, if necessary, to disengage himself from the large car, and leaving it to return, without the necessity of treading on the hanging bars, working the small car by hand.

E. W.

MESSRS. DONKIN AND FAREY'S IMPROVEMENTS IN STEAM ENGINES.

From the London Mechanics' Magazine.

Fig. 1.

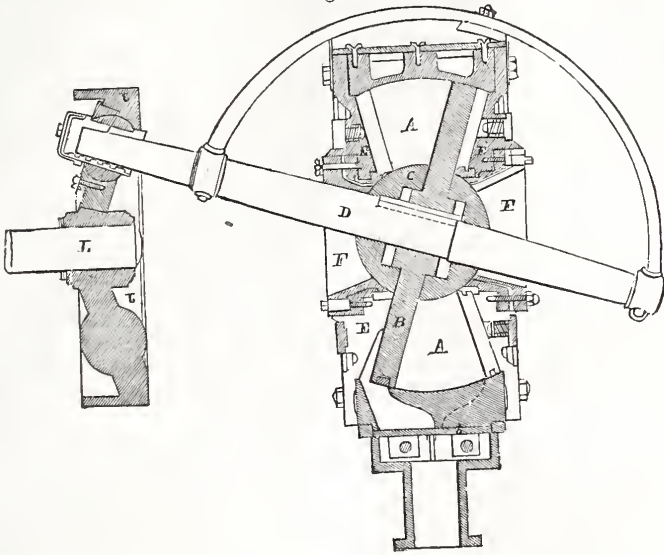


Fig. 2.

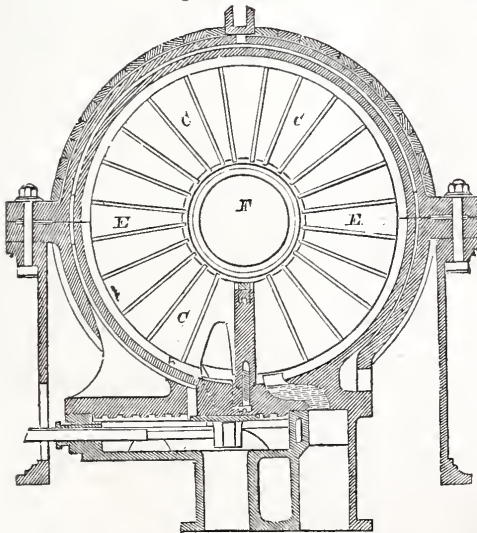


Fig. 3.

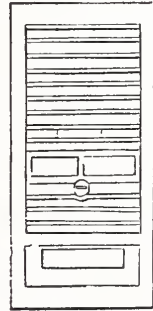
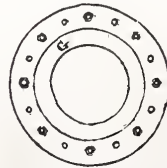


Fig. 4.

*Specification.*

Firstly. Our specification has reference to that description of steam engines commonly called the "Disc Engine," which

engine formed the subject matter of the four several patents for England, following: namely, a patent granted to Henry Davies, of Stoke Prior, on or about the

15th day of March, 1837; another patent granted to the same Henry Davies, on or about the 14th day of June, 1838; another patent granted to the same Henry Davies, on or about the 15th day of July, 1844; and a patent granted to George Daniell Bishopp, of Edgbaston, on or about the 2d day of October, 1845; of which four patents respectively specifications were duly enrolled, containing (one or other of them) a full description of the original construction of the said disc engine, and of the different improvements which have been subsequently and heretofore made therein. Our invention, in so far as it regards the said disc engine, consists, in the first place, of certain improved methods or means of making the working parts thereof steam-tight, and an improved method of forming the bearing for the coned end of the diagonal shaft.

Fig. 1 is a longitudinal section through or near the centre of a disc engine as thus improved. Fig. 2 is a transverse section of the same, taken also through or near the centre; and fig. 3 is an under plan. A is the steam chamber or cylinder in which the disc B oscillates; *a a* the steam induction ports, of which *b b* are the valves; *c* is the ball, which is attached to the disc B, and works in a seat formed for it in the cones E E, and in the outer glands, F F. D is the diagonal shaft, to which the ball *c* and disc B are attached; *c c* are the metallic packings. G G are two inner glands (not used before) which we introduce for the purpose of better preventing the escape of steam from the cylinder between the ball and the cones. These glands (a front view of one of which is given separately in fig. 4) fit into recesses *e e* made for them in the cones E E, and are provided with rings or washers underneath, composed of compressed hemp, or other suitable yielding material. The outer glands F F fit into the glands G G; and *g g* are set screws, which are passed loosely through the glands F F, and tap into the cones E E, so that by turning down these set screws, the inner glands G G may be as tightly compressed as need be against the packing of the ball *c* all round. Or, instead of the preceding arrangement, the set screws *g g* may be made to screw into and through the outer glands F F, and their points to press upon the inner glands G G. The

better also to secure the ends of the metallic packing slips *c c*, we fit to the cones a ring of metal H (a plan and section of which are given separately in fig. 5); on the outside of this ring there is a series of notches or recesses *h h*, and on the top edge thereof another like series of notches or recesses *i i*, which last form (when the ring is in its place) a continuation of the grooves in the cones in which the packing slips *c c* are inserted. Fig. 6 is partly a side view and partly a section of the ring detached from the engine, showing the notches *i i* on the top edge, and also the notches upon the outside. The tail-pieces *k k* of the slips take into the notches *h h*, while the top parts *l l* fit sideways into the notches *i i*, whereby the slips are kept securely in their places under all circumstances. To provide against the wearing away of the coned end of the diagonal shaft D, or the bearing in which it is stepped, we construct that bearing in the manner represented in figs. 7 and 8, which is a section and end view of the same on an enlarged scale, with the shaft in its place. *m* Is a metal tube, threaded on the outside at both ends, which is fitted loosely into the ball I of the driving crank J (fig. 1); *n n'* are two nuts, which are screwed on to the two ends of the tube *m*, one of them, *n'*, serving at the same time as a reservoir for oil or other lubricating material; *o* is a lining to the tube *m*, which is composed of tin or some other soft metal, run in while in a fluid state, upon a mould of the same shape as the coned end of the diagonal shaft D; and *p p* are recesses made on the inside of the tube *m*, into which part of the soft metal flows, forming projecting tie-pieces, by which the lining (after the mould is withdrawn) is kept in its place. Should the conical end of the diagonal shaft become slack in its bearing, it can be screwed close up by the nuts *n n'*, and when the lining itself wears away in any part, it can be renewed with the greatest ease and dispatch.

Secondly. Our invention consists of a new method of applying metallic packings to the disc and cones of disc engines, which may be substituted for those last referred to as invented by G. D. Bishopp (and either in combination with or apart from our improved bearing for the conical end of the diagonal shaft).

Fig. 9 is an edge view, and fig. 10 a front

Fig. 5.

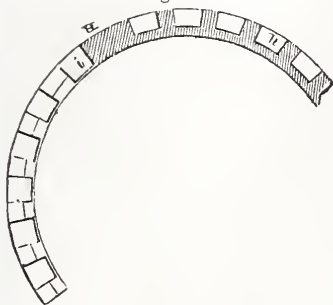


Fig. 6.



Fig. 9.

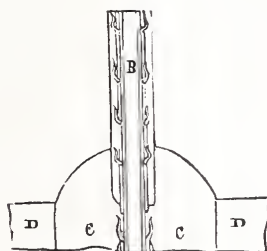


Fig. 11.

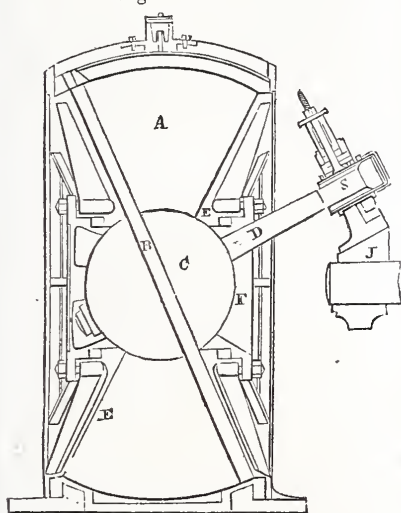


Fig. 8.

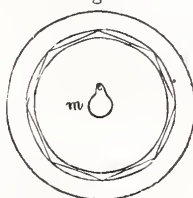


Fig. 12.



Fig. 7.

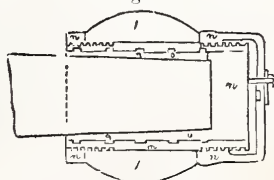
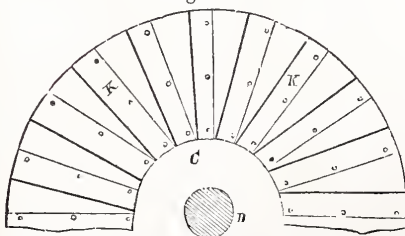


Fig. 10.



view or plan of so much of a disc engine as is necessary to show this part of our invention. B is the disc; c the ball; and D the diagonal shaft, as before. K K are a series of springs (of brass, steel, or other suitable metal), which are attached to each side of the disc, and radiate at equal distances from the circumference of the

ball to the edge of the disc. Each spring is riveted to the disc by one side (as shown in the figures), so as to have a slight inclination outwards on the other side. As the disc rolls over the cones, the springs press against the cones with just sufficient force to keep the joining steam tight. The springs may be at-

tached to the cones instead of the disc ; but we prefer the arrangement which we have figured and described.

Thirdly. Our invention has reference, also, to the disc engine, but is applicable to that engine only, when used without metallic packings, and is intended to obviate altogether the necessity of packings of any sort. Fig. 11 is a longitudinal section through the centre of a disc engine constructed according to this part of our invention. A is the steam chamber or cylinder : *B* the disc ; *C* the ball ; *D* the diagonal shaft ; *E E* the cones ; *F F* the glands ; and *J* the driving crank, all as before. Fig. 12 is a front elevation of the crank *J* detached from the rest of the engine.

The cones *E E* and disc *B* are here supposed to be perfectly plain surfaces, or only covered with leather, felt, or some other yielding substance. In order, therefore, that they may be pressed closely together and any escape of steam between them be thus prevented, we adopt the following arrangement :—

The end of the diagonal shaft *D* rests in a block or bearing *V*, which slides in a slot *q* made in the crank *J*, being kept in sideways by pins *s s*, which take into grooves in *q*. From the block *V*, a pin *t* projects, which passes through the top of the crank, and is screw-threaded at its upper end for the reception of a nut *u* which sets into the washer and guide *w*, between which and the top of the crank, there is interposed a spiral spring *x*. The action of the spring *x* has a tendency to draw the bearing block *V*, and with it the end of the diagonal shaft *D* towards the top of the crank ; and the diagonal shaft *D* and disc *B* being fixed at right angles in relation to each other, it follows that the more the end of the shaft is drawn towards the top of the crank, the closer the disc must be brought to the cones. Should there be any unevenness on the faces of the cones, or should they not be in perfect agreement with one another, the spring will by its own action produce the degree of adjustment or correction required. The springs can be adapted in point of strength to any degree of pressure by screwing or unscrewing the nut *u* on the pin *t*.

Fourthly. Our invention consists of an improved method of working expansion valves, which is applicable both to the disc engine and generally to all rotary or semi-rotary engines.

Fig. 13 is a cross section through the centre of a disc engine with our improved expansion apparatus applied thereto.

Fig. 14 is a plan of the engine with the cover and cones removed, so as to exhibit the bottom of the cylinder only.

A is the cylinder ; *L* the main shaft ; *J* the driving crank ; *w w* are eccentric toothed wheels of an elliptical form, which are fixed on the main shaft *L* (by means of the set screw *x*) and work into and drive another set of similar wheels *x x*,—which last work the slide valves *b b* ; *a a* are the ports by which steam is admitted to the two sides of the disc ; *y'* the pipe which conveys the steam from the boiler to the slide valve box *y* ; *z* is the exhaust passage, and *z'* the exhaust pipe. To adjust the apparatus, the engine is first set at one half of that part of the revolution at which it is desired to cut off the steam ; the wheels *w w* are then adjusted (by means of the set screw *x*) so that the point thereof furthest from the centre of the main shaft shall be in gear with the wheels *x x* at the point nearest to the centre of the shaft on which they work ; the engine is next turned to that part of the revolution at which the steam is required to enter the cylinder and the slide valves *aa* adjusted by means of the set screws *c'c'* and nuts *d'd'*), so as to be just on the point of uncovering the steam ports *a a*. Matters having been thus arranged and the engine set to work, we are enabled, by the elliptical shape given to the eccentric wheels *w w* and *x x*, and the relative positions in which they are placed, to cut off the steam at any point whatever of the revolution that may be most advantageous ; and this because, for every small portion of a revolution, performed by the wheels *w w*, the wheels *x x*, which move the slide valves *b b*, necessarily perform a large portion of a revolution ; that is to say, in consequence of the gearing point of the two sets of wheels being at the point farthest from the centre of the main shaft, a small portion of a revolution of the wheels *w w* suffices to make the slide valves, which are moved by the wheels *x x*, travel a sufficient distance to open and shut the steam ports *a a*.

The face on which the slide valves work is made with grooves or recesses (as shown in figures 2, 3, and 13,) in

Fig. 13,

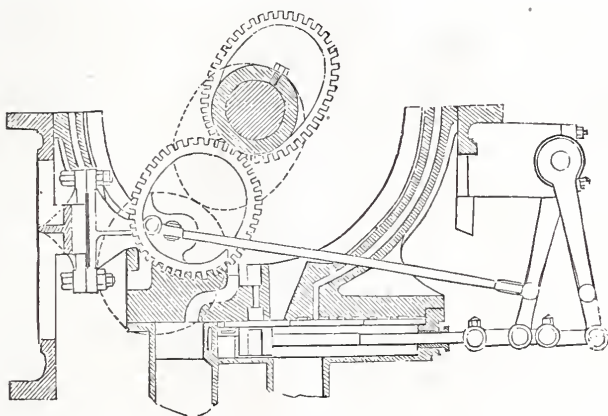
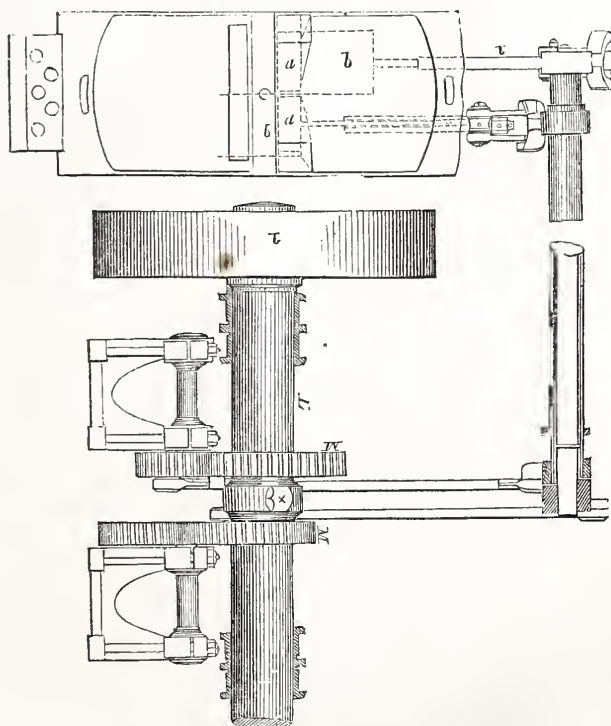


Fig. 14.



order that by the admission of steam into these grooves or recesses, the pressure of the steam upon the back of the

valve may be more or less counteracted.

Fifthly. Our invention consists of an

Fig. 15.

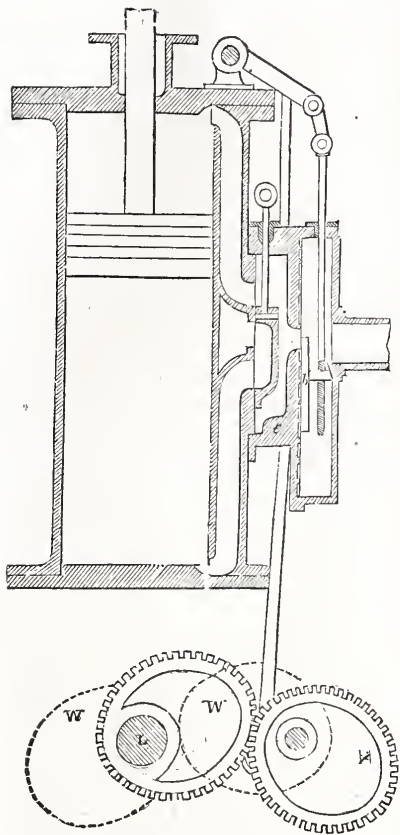
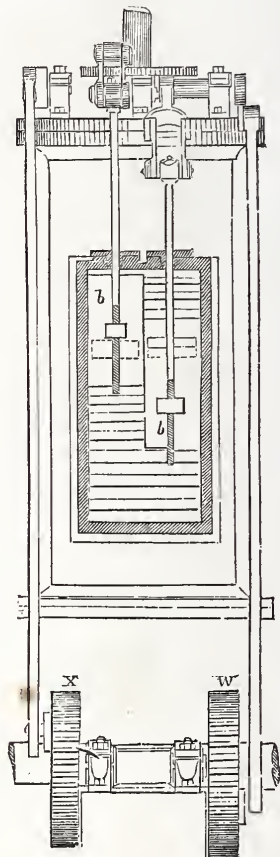


Fig. 16.



expansion apparatus on the same principle as the preceding, but adapted to steam engines of all sorts. Fig. 15 is a longitudinal section through the centre of so much of a steam engine of the ordinary reciprocating sort as is necessary to explain this application. Fig. 16 is a front view of the same, with the back of the slide boxes removed in order the better to show the slide valves. *w w* and *x x* are two pairs of elliptical eccentric wheels as before, the former of which are fixed on the main shaft *L*, and gear into the latter, which work the slide-valve *bb* at the back of the slide box *e'*, of the ordinary slide valve *f*; *g'* is the steam pipe. The different parts act precisely in the

same way as the corresponding parts in the arrangement last before described, and are also adjusted in the same manner.

Sixthly. Our invention consists of a new sort of metallic packing, which may be substituted for the hempen and other soft packings now in common use, and applied to all descriptions of steam engines. We make this packing of shavings, cuttings, or filings of tin, zinc or other soft metal, or soft metallic compound, and compress these together round the piston or other part required to be packed, in the same way as hemp is now ordinarily done. We are aware that it has been before proposed to line the bearings of journals and axles with

soft metal, but the use of soft metal for the purpose of making the pistons and stuffing boxes of steam engines steam-tight, as here proposed, we believe to be new.

[Messrs Donkin and Farey also describe a fluid meter constructed on the same principle as the disc steam engine.]

Claims.—First. We claim the employment of the inner or additional glands *G G*, for the purpose of packing the ball of disc engines, the ring of metal *H*, for securing the ends of the packing slips *c c*, and the peculiar sort of bearing in which the coned end of the diagonal shaft *D*, is stepped, each as before described.

Second. We claim the employment in disc engines of the improved description of metallic packings represented in figs. 9 and 10, before described.

Third. We claim the construction of disc engine represented in figs. 11 and 12, and before described, that is to say, in so far as regards the mode or means by which the diagonal shaft *D* is connected at the outer end to the driving crank, and caused to keep the disc up to the cones, whereby the usual metallic packings are, or may be, wholly dispensed with.

Fourth. We claim the employment in the disc engine, and in rotary and semi-rotary engines generally, of the arrangement of expansion gear represented in figs. 13 and 14, and before described, that is to say, in so far as regards the elliptical shape of the eccentric wheels, *w w*, and *x x*.

Fifth. We claim the construction of the face on which the slide valves work, with grooves or recesses to contain steam, for the purpose of counteracting the pressure on the back of the valve as represented in figs. 2, 3, and 13, and before described.

Sixth. We claim the adaptation of the peculiar expansion arrangement before described, to the ordinary and other steam engines, as exemplified in figs. 15 and 16.

Seventh. We claim the making of the packings of the pistons and stuffing-boxes of steam engines,—of the shavings, cuttings, or filings of tin, zinc, or other soft metal, as before described.

And, *Eighth.* We claim the fluid meter on the disc principle before described, in so far as respects the adaptation to such fluid meters of the several improvements

before specified and claimed, all or any of them.

—
NAPIERS' IMPROVEMENTS IN APPARATUS FOR SEPARATING FLUIDS FROM OTHER MATTERS. Enrolled December 4, 1850.

From the London Patent Journal.

These improvements are divided into four heads, and consist—

Firstly. In the construction of an apparatus, the performance of which is based upon the action of centrifugal force, for separating fluids from other matters, known as the hydro-extractor, in such manner that the matters to be operated upon may be introduced into the machine and discharged therefrom, together with the fluid separated, during the action of the machine.

Secondly. In the suspension of such machines, whereby the vibratory motion resulting from their action is prevented taking any effect on the building in which they are placed.

Thirdly. In the application of a mechanical break, for retarding the motion of hydro-extractors.

Fourthly. In the separation of different fluids from the contents of the hydro-extractor during one and the same operation.

This apparatus, in so far as regards the rotatory perforated drum, is similar to the ordinary hydro-extractor, but differs therefrom materially in its construction, and the other parts of which it consists, whereby to produce the effects before mentioned.

The following page exhibits this apparatus in elevation, section, and plan,—fig. 1 being an elevation of the machine; fig. 2 a vertical section; fig. 3 a plan of the top; and fig. 4 a like plan, with the cover removed. This machine has two external casings, *A* and *B*, which are united by intermediate stays; the inner vessel, *B*, is for the reception of the fluid extracted, while it prevents the matters that have been operated upon flying off by the centrifugal motion with which they have been ejected. These casings are suspended by three rods from a trigonal top, *c*, by which the whole is suspended in any suitable manner. *D* is the shaft of the rotating drum; this is fitted in bearings, *a a*, in which it revolves freely, the motion being transmitted thereto by the pulley, *E*. *F F* is the rotating drum, fixed

Fig. 1.

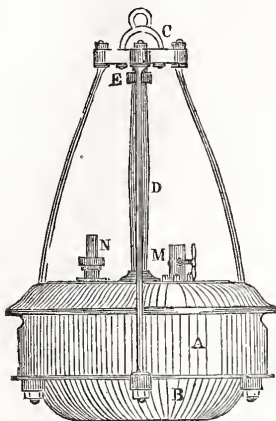


Fig. 2.

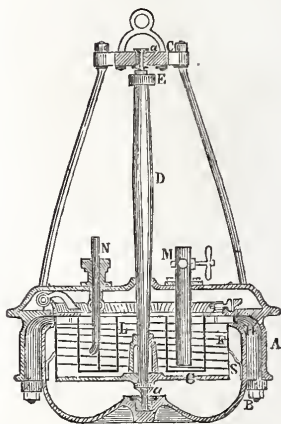


Fig. 3.

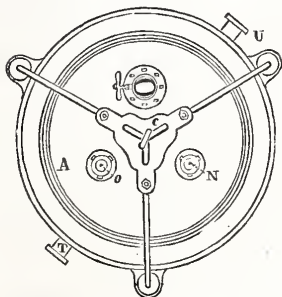
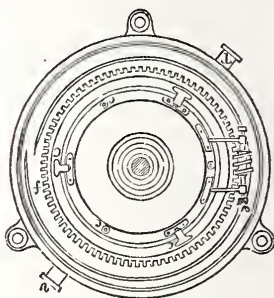


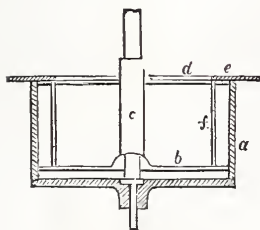
Fig. 4.



on the shaft *D*, and consists of a perforated metal cylinder, having a close bottom, *G*, and furnished with a flange or lip, *H*, on which a ring, *I*, is bolted by studs, *b b*; a second ring, *K*, is fitted within the ring, *I*, in which it is sustained in a central position by the rollers, *c c c c c*, which bear within and upon the ring, *I*. The ring, *K*, is connected with a screw or inclined plate, *L*, of metal, coiled within the drum, but of such a diameter that room is left for the introduction of a reticulated material between it and the drum, *F*, at the same time permitting a separate motion to be communicated to the screw, *L*. Two brackets are mounted on the ring, *K*, for the support of a tangent screw, *d*, which gears with the tooth on the ring, *I*, for the purpose of producing a gradual increase or decrease of speed

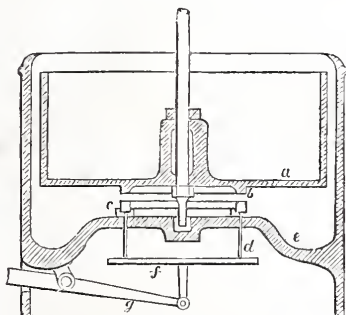
in the ring, *K*, than that resulting from the motion of the drum. On the spindle of the screw, *d*, a wheel, *e*, is fixed, having inclined teeth, which embrace a rib, *f*, projecting from a stationary plate of the casing, *A*, in the form of a volute curve, which, by the wheel, *e*, is caused to rotate with its axis the distance of one tooth during one revolution of the arm, *F*. The ring, *K*, is connected to the incline, *L*, by the rods, *g*, from a plate, *h*, fitted on the boss of the rotating drum. The motion transmitted to the drum, *F*, is thus communicated to the screw, *L*, with the difference due to the action of the tangent screw, *d*, which may be so arranged as either to drive it faster or slower than the drum, *F*, according to the direction in which the screw *L* inclines. The saccharine or other matters to be operated

Fig. 5.



upon are introduced by means of a tube, *M*, connected with the containing vat by a flexible tube; the tube *M* is furnished with a throttle valve to regulate the supply, and is fixed to the cover of the casing, *A*, as also the other supply tubes, *N* and *O*. The saccharine matters, as they descend from the tube into the drum, *F*, are thrown out by the centrifugal force to the perforated periphery; the fluid contained therein passing out through the perforations into the vessel *B*. The sugar retained in the drum maintains its position against the drum, *F*, but is at the same time gradually raised by the screw *L*, until it arrives at the top, when it escapes over the lip, *H*, and falls down the space between the casings *A* and *B*, and is collected below in a receptacle, *R*, from which it is conveyed in any suitable manner. During the rising of the sugar in the drum *F*, it is desirable to introduce fluids, which is effected by the pipes *N* and *O*. These may either be delivered on the bottom with the sugar in the drum, or at any point of its elevation. By curving the pipe *N*, the jet, which is furnished with a rose, distributes the fluid on the sugar, partially raised by the screw. Water or other fluid should not be supplied to the sugar too near the top of the drum, *F*, as it will escape in too wet a state. The patentees propose introducing steam in a similar manner in operating upon sugar by this apparatus. In cases where different liquids are applied to the substances under operation, and it is desired to keep them separated, these fluids are supplied at different elevations by the supply pipes, *N* and *O*. The fluid supplied at the lowest elevation will be received in the vessel *B*, and the other in a circular

Fig. 6.



trough, *S*, each being conveyed away by separate pipes, *T* and *U*, to suitable receptacles. Instead of delivering the matters operated upon around the entire circumference of the outer casing, they may be delivered by a channel at a tangent thereto, the matters being ejected by blades or vanes revolving therein.

The next improvement refers to another mode of ejecting the contents of the drum. A section of this arrangement is represented at fig. 5; *a* is the perforated drum, which has on the inside a false bottom, *b*, supported by a tube, *c*, sliding on the drum spindle, which also sustains by arms, *d*, a ring or annular plate, *e*; this plate, *e*, is connected by uprights, *f*, to the bottom, which is thus steadied and strengthened. The false bottom fits the interior of the drum sufficiently close to prevent the matters passing below. The tube, *c*, is furnished with means whereby it may be raised during rotation, such as a forked lever, embracing a groove in the tube, or by a shackle and rope. The matters under operation that rest on the bottom, *b*, and against the periphery, may be thus raised out of the drum, and on arriving at the upper edge, will be thrown off by the centrifugal force.

The next improvement refers to retarding the motion of rotating drums of hydro-extractors, by means of a mechanical break; this is represented in fig. 6, in which *a* represents the rotating drums on the bottom of which a raised ring *b*, projects. Opposed to this, another ring *c* is supported on upright stems *d*, passing through the bottom of the receiver *e*. A plate *f* supports the rods *d*, which plate

rests on the end of a lever *g*, by which it is raised when required. By depressing the free end of the lever *g*, the plate *d* forces up the ring *c*, so as to come in contact with the raised surface *b*, and according to the pressure, so will be the friction of contact, to produce a greater or less retarding force to the revolving drum *a*.

The several methods of feeding or supplying the matters to be operated upon, and discharging the same, having been described in reference to the preceding part, it will be unnecessary here to repeat that operation.

In conclusion, the patentees observe that although sugar has been mentioned as the material operated on, it will be apparent that the machine will be equally applicable to extract fluids from other matters, such as ground wood and like substances: thus may the coloring matter be separated with the fluid, or the fluid only, depending on the matters treated. Having described their invention, they would have it understood that they do not confine themselves to the precise details given thereof, so long as its peculiar character be retained, but what they claim is—

First. The construction of centrifugal apparatus for extracting fluid from other matters, in such a manner that the supply of matters to be operated on, and a discharge of the matter operated upon, may be effected during the rotation of and by centrifugal force generated in the apparatus.

Secondly. The suspending centrifugal apparatus as described.

Thirdly. The arrangement of apparatus for discharging the drum or rotating vessel of its contents after operating by centrifugal force, as explained.

Fourthly. The retarding and stopping centrifugal apparatus used for separating fluids from other matters, by applying a mechanical force to act on a drum or vessel, to which the rotary motion is imparted.

DEAKIN'S IMPROVEMENTS IN MACHINERY AND APPARATUS TO BE USED IN ROLLING METALS, AND IN THE MANUFACTURE OF METAL TUBES. *Patent dated June 12/h, 1850.*

The patentee's invention relates to rolling machinery for the manufacture of me-

talic cylindrical taper, and other tubes and solids. The first improvement consists in the manufacture of cylindrical tubes, by the employment of a series of grooved rollers, so placed and combined that the metal from which the tube is to be formed, passes quickly between each pair of rollers in succession, whereby the metal, which was previously of the form of a flat plate or skelp, gradually approaches to the form of a cylinder, which form it assumes when passing between the last pair of rollers. When iron is the metal employed, the process of bending and rolling the tubes into the cylindrical form desired, is quite sufficient to perfect the welding up of the joint of the tubes at the same operation. The plate or skelp should be brought to a welding heat previous to its being submitted to the rolling operation, but in some cases the welding up of the joint of the tube may be required to be performed after the bending and rolling has been effected.

Fig. 1 represents a longitudinal vertical section of the machinery for making tubes, taken centrically through the rollers at the line, 1, 1; fig. 2 is a plan view. A A, the side framing of the apparatus, upon which are mounted the four pairs of rollers, B B B B. The patentee does not, however, confine himself to the employment of this number of rollers in each apparatus, as a greater or less number may be used, but he prefers this number generally as most advantageous. These rollers are connected together by means of spur wheels, so that the surface velocities of the rollers acting immediately upon the metal passing between shall be equal, although the diameters of such rollers may be unequal or equal, as most convenient. Immediately in front of the first pair of these rollers, B B, are placed the pair of rollers, c c', the centres of the shafts of these rollers being in a direction at or near right angles to those of the rollers, B B, and therefore revolving at right angles to them. The peripheries of the rollers, B B, are all concave, the concavity of the first pair from the rollers, c c', being greater than the concavity of the other pairs, and this concavity decreases in each pair of rollers until the last, in which the two concavities of the rollers form together a circle. The peripheries of the two rollers, c c', are different from each other, that is, one of them,

Fig. 1.

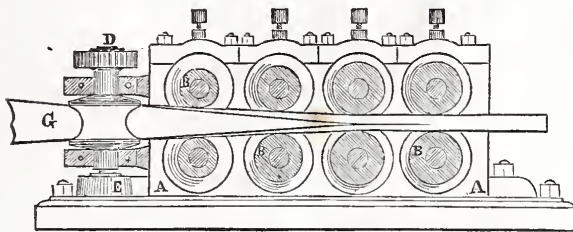
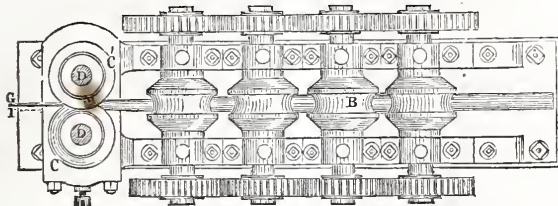


Fig. 2.



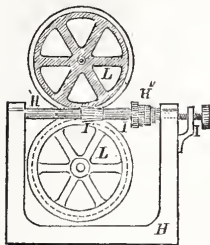
as *c*, is convex, and the other, *c'*, is concave. The lower ends of the vertical shafts, *D D*, carrying the rollers, *c c'*, revolve in steps, *E', E''*, upon the bed plate, *F*, which thereby supports the weight of them and the rollers. The rollers are geared together by spur wheels, and the requisite rotatory motion is given to them, and to the rollers, *B B*, by any well known and convenient means. *G*, represents the plate or skelp of metal in the process of being bent and formed into a tube. The flat skelp is previously heated in a suitable furnace, and then passed through the machine, first between the convex and concave rollers, *c c'*, by which it is bent from its previous flat form, and assumes that of the peripheries of the rollers, being about semi-cylindrical, of considerably larger diameter or radius than that of the intended tube, and then passes on to the first pair of the horizontal rollers, *B B*, by which the edges of the skelp become further bent round, and begin to approach each other, and this rounding gradually goes on in the passage between the remaining pairs of rollers. In passing between the second pair of rollers, the edges are caused to approach nearer together; the action of the third pair brings the edges into contact, and the last pair effects the closing or welding of the joint. When the whole formation of the tube is intended to be effected at one operation of the machine, it is necessary that the skelp

should be at a welding heat when passed into the machine. Thus it will be seen, that at one operation of the machine, the flat plate or skelp will be bent up to the cylindrical form, the joint welded up, and the perfect tube produced at one heat of metal. This result, however, cannot always be obtained, as when very thin plates or skelps are used for the manufacture of tubes. In this case the metal cannot be retained at a welding heat sufficiently long to insure a perfect junction of the edges of the skelp at the last pair of rollers, therefore the skelp is bent up to the tubular form, and the edges brought together at the first operation, preparatory to the welding process, which the patentee then effects by passing it, at a welding heat, between the rollers of a second machine of similar construction to that previously described, but not having any rollers similar to these, *c c'*. The rollers, *B B*, are sometimes arranged in vertical positions, instead of horizontal, as described; the rollers, *c c'*, will likewise be reversed in their position, but their action on the skelp, and the result will be precisely the same as by the first arrangements.

The next improvement consists in the means of manufacturing taper tubes. The machinery employed for this purpose is the same as that previously described for manufacturing cylindrical tubes, except that one or more of the pairs of rollers employed, instead of having their grooves

regular, and of equal size throughout the whole of their peripheries, are formed of varying sizes, either increasing or decreasing, according as the tube to be manufactured is required to be produced of increasing or decreasing diameter. One of the rollers is represented in section, at fig. 3, which shows the form of the groove.

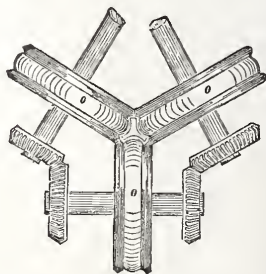
Fig. 3.



It will be seen that proceeding from the cutter, r^2 , fig. 3, in one direction round the roller, the size of the groove is gradually increased until it arrives at the same point, which is the junction of the greatest and smallest portions of the groove; proceeding in the other direction from the same point, the reverse obtains, the corresponding roller working with the one shown in section, both being grooved in a similar manner, so that when working together they present a circular passage of gradually varying diameter, and thereby produce a tube, the taper of which corresponds with the varying size of the grooves; the variation in the sizes of the grooves will of course depend upon the degree of taper the manufactured tube is required to have. The patentee sometimes employs taper plates or skelps of metal in the manufacture of taper tubes, by means of the above described machinery; and when he requires to manufacture tubes with the interior cylindrical, and taper upon the exterior, he then employs skelps of metal of unequal thickness. The means adopted for forming and making the varying grooves in the rollers, so that they shall present a smooth surface, and also that their variations shall be perfectly regular and uniform throughout the circumference, is this:—It consists of a frame or headstock, H, fig. 3, fitted in bearings, in the top of the uprights of which is mounted the shaft or mandril, n^1 , upon which is fixed the driving cone of pulleys or wheels, n^2 , by which the requisite rotary motion

is given to the mandril, H; the mandril is hollow, and slotted upon opposite sides. A rod, I, passes into the hollow of the mandril from one end. The inner end of the rod is pointed or wedge-shaped, and passes into, and bears against a corresponding recess in the end of the cutter, r^1 , which is of two or more parts, the cutting edges of which pass through the slots in the sides of the mandril, and project beyond it. The rod, I, is caused to traverse along the mandril by means of the screw, r^2 , passing through a bracket fixed to the back of the upright carrying the open end of the mandril, the end of the screw bearing against the end of the slotting rod, I, so that as the screw is screwed up, it causes the cutter to expand by acting on the rod. The cutter is, of course, carried round with the mandril. A spur pinion is fixed upon the screw, r^2 , by which a slow but regular rotary motion is given to it, by which the expansion of the cutter is effected at a regular and uniform rate. The rollers, L, L', are mounted upon shafts in a carrying frame, in position shown, the groove to be cut off, one being above and one beneath the cutter. A slow

Fig. 5.



rotary motion is given to the rollers, both moving at equal velocities, at the same time that a rapid motion is given to the mandril and cutters; when the cutter is in the position shown in the drawings, the largest part of the groove required will be cut, because the largest part of the cutter is then in the plane passing through the two centres of the rollers; but as the cutting progresses, the size of the groove cut will gradually decrease, by reason of the cutter being caused to traverse along the mandril, when the small part of the cutter comes gradually into action, until the rollers have made one

revolution, when the cutter will have traversed so far that only the small end of the cutter will be in action, in cutting the smallest part of the groove, where the junction with the largest part of it takes place. The degree of variation of the grooves cut in the peripheries of the rollers will depend upon the form and length of the cutter, and amount and rate of traverse given to it, in relation to that of the rollers upon their axis. In manufacturing other forms of tube, the patentee employs the cylindrical tubes in the manner before described, which are reheated and passed between rollers, the peripheries of which are of such a form as to cause the tubes to assume the exterior form desired. A pair of rollers, the forms or shapes of the peripheries of which are such as to compress the cylindrical tubes between them, and into the form of a hollow railway rail, as shown in fig. 4.

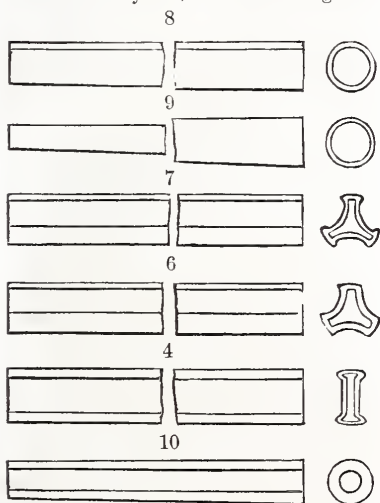


Fig. 5 shows an arrangement of these rollers, 1 2 3, placed triangularly, for compressing and rolling cylindrical tubes into hollow trilateral forms, suitable likewise for railway rails, the peripheries of the rollers being of such shapes as to produce the forms required.

Fig. 6 shows the hollow trilateral rail produced, and rolled by the arrangement of rollers, as shown at fig. 5.

Fig. 7 is another form of hollow trilateral rail, slightly differing from the preceding.

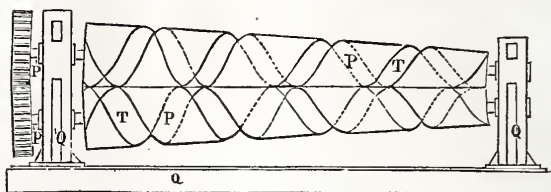
Fig. 8 represents a cylindrical tube.

Fig. 9 is a taper tube, the interior and exterior being of uniform taper, and of equal thickness of metal throughout.

Fig. 10 represents a tube tapered exteriorly, and cylindrical interiorly, and of an equal thickness of metal. Mandrils may be employed or not in the above modes of manufacturing tubes, as convenient.

The next improvement relates to the manufacture of spiral or helical metal tubes. This improvement is illustrated in fig. 11, which represents an elevation of the apparatus. The apparatus consists of a pair of rollers, P P, mounted one above the other in the framing, Q Q, the bearings in which the rollers revolve being in the uprights, Q' Q', of the framing, and the mode of attachment to the bearings being such that the rollers may be removed or replaced with facility, as it is necessary to remove the rollers from the frame before the spiral or helical tubes can be removed from the rollers. These rollers are geared together at one end by the gearing wheels, P' P', so that they revolve in unison. The peripheries of the rollers are formed with spiral grooves, T T, around which the direction of the spiral of one is in one direction, and that of the other is in another direction, so that as the rollers revolve, the grooves of one always coincide with the grooves of the other, and the two together form the exterior of the spiral tube, as is the case with grooved rollers generally. The grooves may be of any form so as to manufacture the spiral or helical tubes of any form of cross section desired. Motion is given to the rollers by any convenient means. When a spiral tube is to be formed, the tube is previously manufactured cylindrical, or of other shape suitable for the purpose, and as the rollers, P P, revolve, one end of the tube is applied to the grooves in the rollers at or near the smaller ends of them, or the reverse, a catch being provided to secure it, and as the rollers revolve, the tube will be drawn between them, and coiled along the spiral grooves, T T, thus forming the spiral tube required, and when the tube has been formed, the machinery is stopped and the rollers removed from their bearings, when the spiral tube may be drawn off. The rollers are then replaced in their bearings preparatory to another operation. The rollers may be formed with any required degree of taper,

Fig. 11.



so as to manufacture tubes of corresponding forms, and the spiral grooves may be made so as to produce spiral tubes either regular or irregular in the pitch of the spirals, increasing or decreasing, as required. When it is required to manufacture helical tubes, the patentee employs cylindrical instead of taper rollers, and proceeds as before described, with respect to spiral tubes. By this improved machine the patentee is enabled to manufacture spiral or helical tubes, in which the direction of the spiral or helix shall be either right-handed or left-handed. This is effected simply by causing the straight tube to be coiled during the process, and wrapped around either one or the other of the two rollers, the grooves of one being right-handed, and the other left-handed, and therefore a correspondingly formed tube is produced. The patentee has hitherto only described this machine as being employed by itself for the purposes described, but it may be used in combination with the machine described at fig. 1, the newly formed tube passing from one to the other.

The patentee claims—

Firstly—the construction and arrangement of machinery for manufacturing metal tubes, wherein the plate or skelp of metal is operated upon by a series of rollers, by which the metal will be bent up and welded to the form of a cylindrical tube, at one or more operations of the machine, as hereinbefore described.

Secondly—The mode of manufacturing taper tubes and solids by the employment of rollers, having grooves therein of varying sizes, as hereinbefore described.

Thirdly—The mode described of forming the grooves of rollers, employed in the manufacture of taper tubes and solids, of regular varying size, by means of a traversing cutter, as described.

Fourthly—The mode described of forming and shaping metal tubes, to be

employed as railway rails, and for other purposes.

Fifthly—The mode described of manufacturing spiral or helical tubes, by means of taper or cylindrical rollers, having spiral or helical grooves upon their peripheries or surfaces, as hereinbefore described.

Sixthly—The employment of the machinery lastly described, for producing solid metal spirals or helices.—*Pat. Jour.*

HARDING'S IMPROVEMENTS IN THE MANUFACTURE OF BUTTONS AND OTHER FASTENINGS. *Patent dated June 12th, 1850.*

These improvements in the manufacture of buttons and other dress fastenings consist in the arrangement and construction of the parts whereby they are secured to the dress, for which two separate methods are given and represented in the drawing.

According to the first method, the button is formed with a shank of a single wire, which, after projecting a sufficient length from the back of the button to pass through the garment, is turned at right angles, and coiled in the form of a spiral in a plane parallel to that of the button. The spiral consists simply of about two turns, and terminates abruptly. On securing this button to the garment, the end of the spiral is inserted through a small eyelit-hole, just sufficient to admit the entrance of the wire; the button is then turned round, and the wire screwed through the hole in the garment until the whole of the spiral passes underneath the vertical shank then occupying the hole, and the button is thereby secured, in which position it is held until the button is drawn from the garment and turned in the contrary direction. This mode of securing dress fastenings is also applicable to other fastenings, such as clasps, &c., the mode of attachment of which is precisely simi-

lar, the spiral and shank being attached to the article in any suitable manner to occupy the proper position for the purpose.

The second fastening is for a similar purpose, but for securing the ordinary description of shank button, or other dress fastening having a suitable shank. It merely consists of a piece of doubled wire, so as to form an eye; the continuations of the wire form a hook and clasp pin after being threaded through the shank of the button; the pin portion is sprung into the hook part, whereby the wire is securely retained in its position. The button shank is first introduced through an eyelid-hole, and the fastening placed at the back, as described.

The patentee claims—

First—The construction of a dress fastening as described in the first part, which is attached and forms a portion of the button or other article.

Secondly—Construction for the wire fastening described for shank buttons or other articles having a similar loop for securing the same to a garment.—*Pat. Jour.*

EVERITT'S IMPROVEMENTS IN THE MANUFACTURE OF METAL TUBES FOR LOCOMOTIVE, MARINE, AND OTHER BOILERS.
Patent dated June 12th, 1850.

The mode described in this specification of manufacturing tubes for steam engine boilers, is intended to remove the disadvantage attending the ordinary cylindrical and parallel tubes for the same purpose, of one end of the tubes being sooner worn out than the other, caused by the greater degree of heat to which those ends nearest the fire are exposed, it frequently happening that those ends so exposed are entirely burnt out or destroyed whilst the other ends are in a good and sound state. To remedy this inconvenience, the tubes have sometimes been made of greater substance at the fire end than the other, but considerable difficulty has been found in manufacturing them. The patentees propose to manufacture them as follows:—the tubes are to be cylindrical, and of the same thickness of metal throughout, and into one end of the tube they insert a shorter tube of the same or of another description of metal, fitting it tight into the longer tube, and then draw them together through a

draw plate in the usual manner of drawing, employing a mandril of two diameters, the larger diameter to fit the interior of the larger tube only, and the smaller diameter to fit the shorter length of the tube within the larger; the mandril is then removed as usual, and may be made slightly taper, to facilitate its removal. By the process of drawing, the shorter tube will be pressed into close contact with the longer tube, and thus produce the same effect as increased thickness in the tube itself. The length of the short tube is to be always more than twice its diameter, and less than one half of the length of the longer or outer tube. The end of the short tube may also, when fitted into the boilers, be made to act the part of the usual ferrule, which it will then supersede.

The patentees claim—the manufacture of tubes for locomotive and other steam boilers, by inserting within one end thereof a shield or short tube, the length of which is greater than twice its diameter, and less than one-half the length of the outer tube.

SAMUEL ELLIS'S IMPROVEMENT IN MACHINERY OR APPARATUS, APPLICABLE TO CARRIAGES USED ON RAILWAYS. *Patent dated June 11th, 1850.*

The specification of this patent describes an improved mode of transferring railway carriages from one line of railway to another,—the means of transferring being attached to each separate carriage, and forming a portion of such carriage. The annexed engraving will illustrate the invention; *a a*, the ordinary frame of the carriage; *b b*, the running wheels. To the framing of the carriage is attached brackets, *c c*, which carry shafts, one of which is shown at *d*, the other being placed in a similar situation upon the other side of the carriage. Each of these shafts carry upon them, near the middle of their length, a worm wheel, which gears into, and is worked by a worm upon the transverse shaft, *e*, the bearings of which are in brackets likewise, fixed to the framing of the carriage. Upon the end of this shaft a winch handle is affixed, by which the worm shaft is turned, and the apparatus put in motion. Upon the ends of the shafts, *d*, are fixed small cranks, to the pins of

Fig. 1.

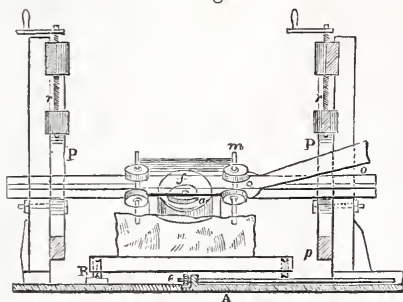


Fig. 3.

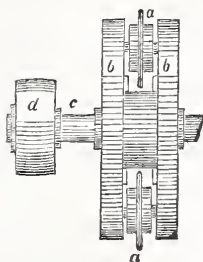


Fig. 2.

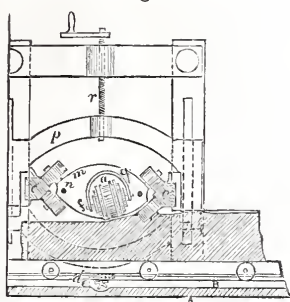
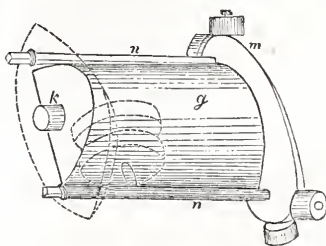


Fig. 4.



foundation A, which travels on a railway B. On the railway a truck, c, is placed, for carrying the stone to be operated upon. On the underside of the cross-framing of the truck, there is a rack d, into which gears a pinion e, mounted on a shaft connected with the main driving power: by giving motion, therefore, to this shaft and pinion, the truck may be slowly moved along the railway, whereby the stone will be brought under the operation of the cutters. Over the rails is next erected a substantial framing for supporting the cutting apparatus. The edges of the cutters may be ground sharp, with an equal bevel on each side; or, for some purposes, they may, as before mentioned, have saw-teeth cut in them. Several cutters may, if required, be put upon one axle, as shown at f, fig. 2;—washers being inserted between the cutters, to keep them at a proper distance apart. A thread, to form a screw, is cut on the spindle inside of its journals; and two nuts, i i, serve to pinch up the cutters and washers firmly together. The spindle, with its cutters, is mounted in the stock or carrier, which consists of a hollow semi-cylindrical piece, g, fig. 4. At

each end of the cutter-stock there is a projecting axle k, by which it is mounted in a frame, consisting of a double cross-head m. In this cross-head the cutters may be set to any angle by turning the stock g, on its axles k. To hold the stock securely and retain it in any given position, there is a bolt n on each side, inserted in the cross-heads. One end of each bolt is screwed, and works in holes tapped to receive it. The other ends are squared and have a flange or shoulder which presses on the outside of the opposite cross-head: the position of this latter cross-head is shown in fig. 4, by dots only, in order that the other parts may be more clearly seen.

It will now be understood, that by applying a wrench to the squared end of the rod n, the cross-heads m will be drawn up together, and made to press hard against the ends of the cutter-stock, and thus firmly hold it in its place. The cutters thus secured are next mounted on the guide-rails o, which are secured to the moveable frame p. This frame consists of strong yokes, which move up or down on the slotted posts of the frame, to which, however, they are firmly held

or secured by bolts, at any required altitude, when the machine is in operation. By moving these yokes up or down, the guide-rails *o o*, and the cross-heads with the cutters attached, may be raised or lowered, and fixed at any required level. Vertical motion of the moveable frame *p p*, and the other parts connected therewith, may be effected by mechanical means, such as a rack and pinion, or vertical screws, as at *r r*. The cross-heads are, as above mentioned, supported by and work upon the guide-bars or rods *o o*; suitable grooves being made on each side, or friction rollers provided for the purpose, as shown in the drawing. The cutter-frame is propelled back and forth by means of any suitable connection with the driving power. In the engraving, the reciprocating motion of the cutters and their frame is shown as being effected by means of a connecting-rod and crank, that being one of the most convenient modes of effecting the required object.

The operation of the machine is as follows: Having placed the stone to be cut upon the truck *c*, and properly secured it in its place by clamps, the cutter-stock should be turned on its pins *k*, so that the cutters, when made to advance across the face of the stone, may assume an angular position, as shown at fig. 2. All the parts being put in motion, the cutters and their frame will be propelled rapidly back and forth on the guide-bars *o*, while at the same time the truck will be made to advance slowly with the stone. As the first end of the stone approaches the cutters, the vertical frame *p* must be adjusted by means of the screws *r*, so that the cutters may take a proper hold on the stone. By giving the cutters the angular position shown, they will cut in different planes, each taking a deeper cut than the one preceding it, as is shown in the drawing. The action of the cutters is produced by rolling over the stone under pressure. When the stone has passed completely through the machine, the cutter-stock is to be turned, so as to give the cutters the requisite angular position in the reverse direction. The motion of the pinion *e* also being reversed, a second cut may be taken from the face of the stone, if required; or another side of it, or a new stone may be presented to be operated upon; or, the

truck *c* being stopped, the cutters may, if required, be made to pass vertically down the end of the stone, by working the screws *r r* before described; or this may be performed by a separate machine, peculiarly adapted to this purpose, which would perhaps be the most convenient plan. In the arrangement above described, it will be seen that the cutters are so contrived as to be brought down upon the stone, and also made to move over its surface; but the arrangement may be so far changed or modified that the stone shall be caused to move back and forth under the cutters; while the latter remain stationary, except that they will have a rotary motion on their axle. The speed with which the stone should move under the cutters must vary with different qualities of the material to be dressed or operated upon; and this may be regulated by changing the speed of the pinion *e*, which can be accomplished by the use of cone-pulleys, or of different sized gear wheels, as may be preferred.

Fig. 2, shows, in edge view, another mode of mounting the cutters. In this instance, one or more of the cutters, *a a*, are mounted in a circular stock, and caused to rotate with the stock, by giving rotation to the shaft which carries the stock. *b*, represents the stock; *a a*, the cutters; *c*, the shaft on which the stock is mounted; and *d* is a pulley, to which motive power is applied for driving the same.

It will be obvious, from the foregoing description, that this part of the invention is equally applicable to the dressing, facing, and reducing of stone and other material into circular, curved, or irregular figures, as well as to a flat surface, as above described,—it being only necessary to give to the frame, which carries the cutting or dressing-roller, a feeding motion in the plane of the figure to be produced, or to impart such motion to the material to be operated upon. Or the required figure may be produced by a compound motion of the cutter-frame and material to be worked; as for instance:—To produce a cylinder or column, the material to be worked can be hung in a lathe, and a rotary motion communicated to it, whilst the cutting or dressing-tool is mounted in a sliding rest, which has a slow progressive motion from end to end; and, for producing varying diameters, an additional motion can be given to the rest

towards the axis of the lathe-mandril; or, instead of this, the lathe-mandril can, in addition to its rotary motion, have a motion towards and from the rest.—*P. Jour.*

USEFUL HINTS ON VENTILATION.

BY W. WALKER, ENGINEER, MANCHESTER.

From the Civil Engineer and Architect's Journal.

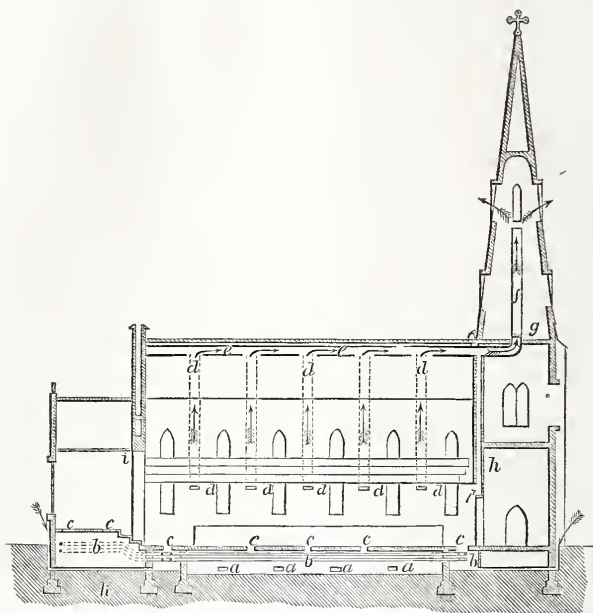
However useful steam-agency, as applied to ventilating purposes, may be in factories or buildings connected with them, and in theatres or other places liable to great and sudden influx or efflux of persons; and well as it has been found to answer in its application to other buildings, such as club-houses, banks, collegiate institutions, and hospitals, in which manifest advantages have been derived from its employment; there will still be great numbers and many classes of edifices in which it would be from various causes inadmissible. Churches, chapels, and houses for worship, may be enumerated under this head—the numbers contained within their walls being, on the whole, tolerably constant, and not liable to very sudden fluctuations; but especially from the circumstance that they are seldom used more than two days in the week, with intervals of two or three days between; and when used it is only for two hours consecutively, with intervals of two or three hours between. With such proper quantity and sizes of ingress and egress flues as can readily be obtained in the thick walls and piers of such edifices (if planned prior to their construction), this short period of occupation will not permit their atmosphere to become very highly charged with impurities, while the intervals between the services will be found sufficient for an entire change of the whole atmosphere left in them at the close of each service, without resorting to mechanical means. In churches with lofty open roofs, of the mediæval or early English construction, without galleries, the total cubic space bears so large a proportion to that portion of it occupied at the floor level by the congregation, that scarcely any injurious vitiation of the entire atmospheric contents can take place during the short period of occupation, provided moderate preparations have been made for ingress and egress. Hence, very sudden and powerful ventilation is scarcely required in such churches, and the purification of their at-

mosphere may safely be left to the spontaneous action of those preparations; but on special occasions, and in hot weather, the action of the fresh-air flues may be accelerated by the exhausting power of a shaft or trunk of adequate size running up within the tower or steeple, its upper end discharging into the external air, while its lower end communicates with the interior by openings in or near the roof; and this shaft may be made, in very hot weather, to perform two or three times its usual duty, by rarification produced at its lower end, *g*, by a large number of gas burners fixed there in tolerably close proximity with each other, and supplied with gas from the mains which furnish light to the whole building. These ideas have been successfully carried out in numerous instances, and in large buildings. The whole process recommended for such a building will be better understood by a reference to the upper portion of fig. 1, which represents a section of a church ventilated in this manner: *a a*, are openings all round the church for admission of fresh air; *b b*, hot-water pipes, over which it is made to pass on its way to the gratings, *c c*; *d d* are openings, by which the vitiated air enters a horizontal trunk, *e*, from the end of which rises the shaft *f*, with a collection, *g*, of gas-jets in the bottom of it; *h i* is the gallery-line, and *k*, an excavated room for the boiler, the floor of which should be five feet below the floor-line of the church.

By simply turning the cock in the gas-pipe which supplies the jets, the rarefaction in the shaft, and, consequently, the velocity and quantity of the air passed through the church may be controlled with tolerable accuracy, and instantly proportioned to any greater or smaller number of persons assembled. The cost of piping and cock for bringing the gas to the jets has been found to be but trifling; and as they need only be lighted during the time the church is occupied for worship, which is seldom of longer duration than two hours and a-half, the consumption of gas is not very great, and amply compensated by the beneficial result obtained.

The means most proper to be adopted for the plentiful supply of fresh air in the low-roofed, galleried, and crowded meeting-house, will be found to consist in

Fig. 1.



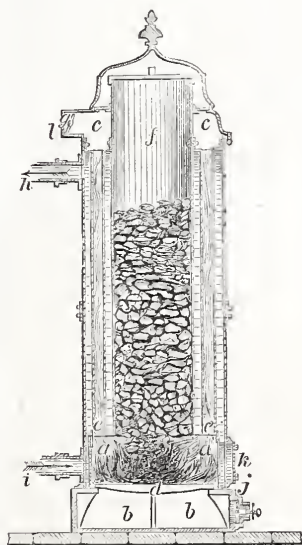
abundance of fresh air openings all round under the windows, communicating by brick flues with the lower part of the spaces under the aisles and seats in which the hot-water pipes that are to warm the air should be fixed. Fresh-air flues should be constructed in all the piers between the windows, running as high as the gallery, to supply it with fresh warmed air. A vitiated air-flue should also commence in each pier under the gallery (in order to give free egress to that which would otherwise be intercepted and detained under the gallery), and pass up into a horizontal trunk, running over the roof, along each side, into the foot of the upright shaft below the gas-jets, as before explained. Openings should also be left in the roof, communicating with these horizontal trunks, to carry off the bad and heated air over the galleries. Hot water pipes should be conveyed along the sidewalls, under the floor, so as to warm the air that passes up within the piers into the gallery.

The leading points to be observed in such a case are delineated in the lower part of fig. 1, below the line *h i*.

A much larger provision should be made for supplying fresh air to such a house for worship, or other galleried building, than in one which has no gallery, and which possesses the advantage of an open roof; and those who would object to the copious measures here recommended, as unnecessary, should well consider the following facts and calculations. A chapel or meeting-house with large galleries nearly all round, capable of accommodating on special occasions 2000 persons, is frequently made about 75 feet square, and 25 feet average height, giving a total cubic content of rather more than 140,000 feet. Now the authorities from Tredgold to Reid who have written on the subject of the quantity of fresh air required per minute by each individual, to replace that which such individual has rendered unfit for respiration, vary in their conclusions from $3\frac{1}{2}$ to 10 cubic feet; and if seven cubic feet be assumed to be the proper quantity, an allowance near the average of their scientific opinions will be given. The total quantity required, therefore, on this low standard in such a building, to maintain its atmos-

phere in a state of purity when filled, will be $(2000 \times 7 =) 14,000$ cubic feet every minute, and a like quantity of vitiated air must be carried off in the same time. The atmosphere of the building will therefore require to be completely changed or renewed $(140,000 \div 14,000 = 10)$ *once in every ten minutes*. Let it now be supposed that the unusual provision of 16 openings has been made all round the building, for fresh air, each opening measuring 18 inches by 6 inches. Deducting one-third of the area for impediment caused by gratings, will allow to each opening a clear area of half a superficial foot, and the aggregate area of all the openings will be eight feet. Now, to supply the required quantity of air (14,000 cubic feet) in the given time

Fig. 2.



a, Fire-box; b, Ash-box; c, Smoke-box; d, Fire-bars; e, Smoke-tubes; f, Fuel-box; g, Damper; h, Flow or steam-pipe; i, Return or condensation pipe; j, Ash-box door; k, Fire-door; l, Smoke-pipe.

(one minute) through those openings, the air must pass through them all at the velocity of $(14,000 \div 8 =) 1750$ feet per minute, or more than twenty miles per hour: which it will not do, especially on a calm day in hot weather, *when ventilation is most needed*, without the aid of some powerful stimulus; and if such artificial impulse be wanting, those open-

ings will, under the circumstances, be quite insufficient to prevent the rapid deterioration of the atmosphere within, and ought, therefore, to be considerably enlarged. The bad effects of the usual way of obtaining a partial supply of air in such a case by opening the windows, have been already commented on.

Take another example from a large Gothic church, with galleries and lofty side aisles and nave, in the neighborhood where this is written; measuring 80 feet by 65 feet, with a roof approaching to flatness, about 30 feet in average height. This church has often contained 1800 persons; its cubic contents being 156,000 feet, and the requirement of air, allowing, as before, seven feet per minute to each person $(1800 \times 7 =) 12,600$ feet. The time in which the whole atmosphere of this church would, when containing its full complement of persons, require to be changed, is $(156,000 \div 12,600 =) 12\frac{1}{2}$ minutes; and large openings will obviously be required to pass the quantity in the time.

These figures will suffice to show the necessity for a very much larger provision for ventilation than has been customary in buildings containing galleries, in which the cubic contents bear a small proportion to the numbers assembled.

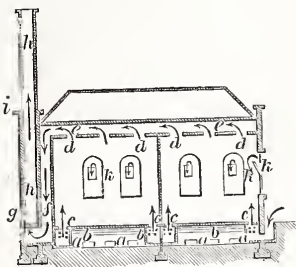
The management of the warming of a church being a matter frequently intrusted to a sexton or verger charged with other duties, which necessitate his making a clean appearance, and demand his exclusive attention during the service, it is a matter of some importance, where hot-water apparatus are used, to adopt such form of boiler as will require the smallest possible attention. The kind shown in fig. 2 in the annexed section, will be found to fulfil this requirement; many large churches having been kept by it at a uniform temperature with only three attendances in twenty-four hours. This sort of boiler will be found very desirable in many other buildings besides churches. They are to be filled to the top with coke broken into small pieces, which falls on the fire as required. A very useful kind of Arnott stove has been largely adopted on the same principle.

The stove here described appears to us a very simple arrangement for effecting the purposes desired, and to be well worthy of adoption.

In the whole range of ventilation there is, perhaps, nothing so much neglected as the ventilation of schools; and as it is most desirable public attention should be turned to the subject, we most willingly give room to Mr. Walker's statement of his views on the subject:—

"Schools are frequently very crowded, and their atmosphere in a most unwholesome condition. The great increase in their number in the populous manufacturing districts, is a gratifying sign of the times, and affords good reason to hope that the succeeding generation will grow up with improved ideas and habits, and, as is most needful in those districts, stand some degrees higher than their predecessors in the scale of civilization.

Fig. 3.



"Fig. 3 is a section representing a boys' and girls' school ventilated (except as regards the windows) in a satisfactory manner; *a a* are the fresh-air openings; *b b*, pipes for heating; *c c*, gratings for entrance of fresh warmed air; *d d*, openings for foul air, leading into a trunk *e*, whence it is drawn down the shaft *f* by the rarefying furnace *g*, whence it is discharged up the shaft *h* into the atmosphere.

"This arrangement of a rarefied shaft, continued down to the ground for the purpose of obtaining a quick draught by a heated column, and requiring a down shaft to connect the ventilating trunk from the top of the building, with its lower end, so that the foul air may enter it below the fire, is the same that has been adopted, at very great cost, by Dr. Reid, in the new houses of Parliament. There is a complexity and expense about this arrangement which would seem to be needless. The drawing down to the ground-level of the whole of the vitiated

air of the building, and then sending it up again; the cost of connecting the main down-shaft with the up-shaft, which circumstances may require to be at a considerable distance; and the trouble of forming air-tight connecting-flues to convey the vitiated air from numerous rooms to one main down-shaft, to say nothing of the double space and materials occupied by the two shafts, would render this plan in numerous cases impracticable. To overcome some of these difficulties, the fire has, in many cases, been provided for at the roof level (*i* fig. 3), thus relinquishing the down-shaft and the lower part of the up-shaft, and so far has been an improvement; but in many cases the trouble of carrying up fuel and ascending to attend to the fire was too great, and the ventilation was, therefore, uncertain. The best mode of effecting forcible ventilation by a shaft doubtless is, to adopt the last-named arrangement; substituting gas rarefiers for a furnace, as shown in the church. (Fig 1.) By bringing the pipe which supplies gas to the burners to some accessible point near the ground-floor, with a stop-cock at that point, the handle of which should work in a graduated quadrant, the ventilation can be regulated from below with great precision.

"Window-ventilation of a kind very frequently adopted in churches and schools, has been introduced into this figure (*k* fig. 3), not with a view to represent it as part of Dr. Reid's system, but to illustrate its bad effects, either where it is the sole provision made, or where it is used in combination with a better process. If it be the sole provision made, and the room be heated by a fireplace or stove, to 60°, a downward rush of air at 10° (should that low temperature happen to prevail outside at the time), will play upon the heads of those near it. If it be in force, as in the figure, simultaneously with proper means of introducing fresh warmed air, its force will be modified, and partially deflected upwards, towards the egress openings; but whatever cold air thus enters, is so much deducted from that which ought to have entered warmed, through the proper channel *c*."

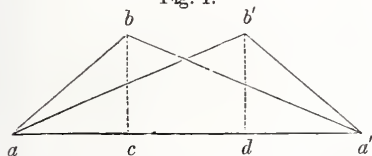
We may observe, that Mr. Walker has been largely engaged at Manchester in the construction and adaptation of stoves, and that he has had considerable expe-

rience in many practical applications of ventilation.

TRACTS ON BRIDGE BUILDING.—NO. II.
For Appletons' Mechanics' Magazine and Engineers' Journal.

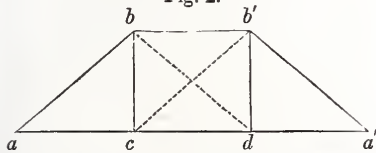
We have shown the method to be pursued in calculating the strains on the respective braces or rafters, and ties or chords of a piece of framing, which may be either a truss for a roof, or for a bridge in its simplest form.

Fig. 1.



For short spans of either roof or bridge, say from thirty to forty feet, either of the two following forms may be used: The simplest is that shown in fig. 1, the truss resting on the points a a' , and the roadway bearing on those points, and on cross bearers at the points c and d . This form of truss is, however, less economical than that of fig. 2, and less rigid.

Fig. 2.



For the purpose of comparison, take a a' , in figs. 1 and 2, divided into three equal parts at the points c and d , and suppose, with the same height b c to the two trusses, the points b' b to be loaded with a weight, w .

Now it is clear that the weight on the points a and a' is the same in each truss, but the tension on the tie is in the case of fig. 2, at a , $\frac{a}{b} \frac{c}{c} w$; but the tension on the tie of fig. 1 is, as shown in Tract No. 1, $\frac{2}{3} \frac{a}{b} \frac{c}{c} w + \frac{1}{3} \frac{a}{b'} \frac{d}{d} w$. Substituting in this expression the value of a d , which $= 2 a$ c , and of b' d , which $= b$ c , we have the tension $= \frac{4}{3} \frac{a}{b} \frac{c}{c} w$, which is $\frac{1}{3}$ greater than in the case of fig. 2; of course re-

quiring $\frac{1}{3}$ more material; which excess is not offsetted by the additional material required in the braces b d , b' c , of fig. 2, which is the preferable form, unless the abutments sustain the thrust; for in the latter case in fig. 2, the braces b' c , b d cannot act directly on the abutments, as they may do in the case of fig. 1.

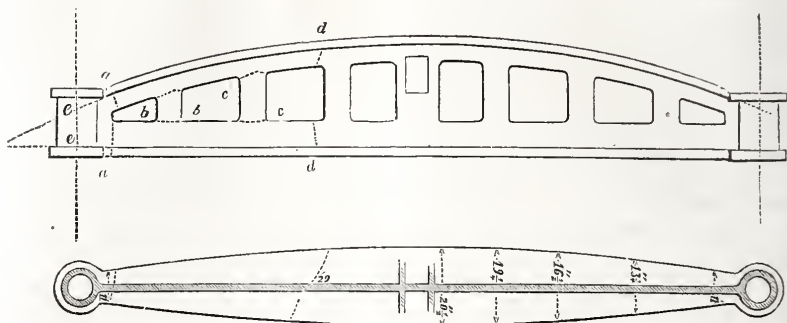
CAUSE OF THE BREAKING OF THE LARGE CAST IRON BEAM IN STOCKPORT MILL, ENGLAND; NOTICED IN THE FIRST NUMBER OF THIS MAGAZINE, PAGE 11.

For Appletons' Mechanics' Magazine and Engineers' Journal.

The beam was composed of top and bottom flanges, and a connecting web—the web being cut away excepting 7" in width next the upper, and 8" next the lower flange, and excepting seven upright bars from seven to nine inches wide. See diagram. The top flange was arched so as to give the depth of beam, about 40" in the middle, and 20" over the centres of the end supports, which were 20 feet apart. The top flange was 2" thick by 9" wide in the middle, and about 1 $\frac{7}{8}$ " by 7" at the ends: lower flange, 3" thick by 20" in the middle, and 11" wide at the ends. The web, 3" thick at the bottom and 2" at the top.

The arch of the top rib or flange had a versed sine of about $\frac{1}{12}$ the length of chord; and if we suppose the horizontal thrust to be the same as that of two straight braces, from the vertex to the extremities (and it cannot be less, with the load all in the centre), it would amount to a force equal to three times the amount of load in the centre, which was stated at about 80 tons, giving a thrust of about 537,000 lbs. This thrust, which should be sustained by the tension of the lower portion of the beam, had its action in a line meeting the axis of the supporting column, at a point, e , about 15" above the intersection (e') of said axis, with the centre, or axis of resistance of the lower portion of the beam; consequently, the thrust had a tendency to shove the end of the upper over that of the lower portion, and to bend or break both portions at a a , by tearing them open on the upper side; also, to break off the upright bars, b b , c c , &c., of the web, by opening them at b b and c c , which being done, the top and bottom portions of the beam,

Diagram.



at *d d*, could act only by their lateral stiffness, without affording any aid or support to one another, and, of course, would offer but feeble resistance to the effects of the immense load in the centre of the beam.

To estimate (approximately, of course) the resistance capable of being offered by the parts above named, to the thrust of the arch, we may regard the thrust, as to its tendency to produce rupture at *a a*, as acting on a leverage of 15", equal to the distance between the intersections of the axis of the supporting column, with the axis of the top and bottom portions of the beam; and the extreme resistance capable of being offered to thrust by these portions, considered as of simple rectangular cross sections, would be about 6000 lbs. to each square inch of section, multiplied by the depth of section, and divided by the leverage at which the force is applied. The top portion of the beam, at *a*, then, being about 27 square in. in section, and 9" deep, would give a resistance of $6000 \times 27 \times \frac{9}{15} = 97,200$ lbs. For the bottom portion, at *a*, with 11" depth and about 56 square inches of section, we have $6000 \times 56 \times \frac{11}{15} = 246,400$ lbs.

The upright bar, *b b*, being 7" wide, about $10\frac{1}{2}$ inches long (the leverage), with an aggregate section of about 35 inches at the two ends, might resist thrust with a force of $6000 \times 35 \times \frac{7}{10.5} = 140,000$ lbs.

The upright, *c c*, 8" wide, 16" long, with 40 inches in its two end sections, could resist with a force of $6000 \times 40 \times \frac{8}{16} = 120,000$ lbs., making the aggregate

resistance of all these parts equal to 603,600 lbs.

But we have before seen that a load of 80 tons on the middle of the beam, could not produce less than about 537,000 lbs. of horizontal thrust on the arched portion of the beam; and we now see that the parts broken (except the top and bottom flanges, at *d d*, which could produce but little diminution of stress on the other parts broken), could only sustain the effects of a thrust of about 603,600 lbs., upon the supposition that they were quite sound and of ordinary strength, and upon the further supposition that all the broken parts (except those at *d d*) were equally strained, and came to the point of rupture at the same instant; which, of course, was not the case, as the parts near the end would, obviously, receive the first strain, and first arrive at the breaking point, before other parts could have their full powers of resistance brought into action.

I conclude, then, that the breaking of the beam in question involves no mystery, and should excite no surprise; that it was not occasioned by any defect in the strength and texture of the metal, occasioned by unequal shrinkage in cooling, or any thing else; but that it was occasioned by causes purely mechanical, and might easily have been foreseen and prevented by a just knowledge of mechanical principles.

I will only add a few brief remarks, the justness of which must be obvious to every good mechanic and engineer.

First. It is exceedingly injudicious to form an open work beam with its upper

side in a curved form, when it is intended it is to bear its whole load in the centre.

Second. It is gross folly to build an open, arched girder in which the axis of the arch does not meet that of its chord, which is to sustain its thrust, as nearly as may be, over the centre of the supporting force.

Third. Common intelligence should dictate that, in a case like the one involving the sad consequences of the breaking of the beam in question, the beam should be composed of two sufficient cast-iron braces, like the rafters of a house (either cast separately or in one piece), with the feet connected by a sufficient wrought-iron tie, meeting the axis of the braces over the centres of the end supports.

S. WHIFFLE.

ON RAILWAY CARRIAGE AND WAGON SPRINGS,

BY W. A. ADAMS.

The substance of a paper read before the British Association of Mechanical Engineers.

The writer endeavored to illustrate that the true and correct form for a laminated spring is a triangle tapering at a uniform rate from the centre to each end; and, further, that the spring should not be weakened in the centre by a bolt or rivet hole. He intimated his intention of preparing a laminated bearing spring with axlebox and adjustments complete, according to these principles, and thus endeavor to produce the same results as in the ordinary laminated spring with the smallest amount of material.

Fig. 3.

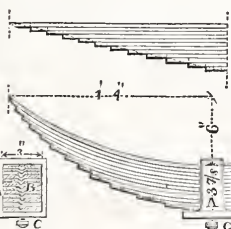


Fig. 1.

Fig. 2.



Fig. 1 represents a spring and adjustments of the following dimensions, which has been made according to the above principles, and is laid before the present meeting:—

Length, ... 2 ft. 8 in.
Camber, ... 6 in.
Width, ... 3 in.
Thickness in centre, . . . 3 $\frac{1}{8}$ in.

Consisting of 10 plates $\frac{5}{16}$ inch thick, and 2 plates $\frac{3}{8}$ inch thick.

The weight of the spring, exclusive of the hoop, is 59 lbs.

This spring is very nearly a triangle, the base being but $\frac{1}{4}$ inch wide. To insure the correct triangular form, the plates are cut to the correct lengths, as shown in fig. 3, and afterwards cambered.

In this spring there is no rivet or bolt hole, the plates being held together by the clip A. The clip is rounded at the top and bottom, as shown in the section fig. 2, and the spring is therefore confined at the extreme centre only.

To prevent the plates sliding one past the others, they are studded one into the other at the centre, as shown at B, fig. 2. To prevent the spring sliding from the hoop, a set screw, C, figs. 1 and 2, is fixed in the bottom of the clip, the point of the set screw fitting a countersink in the bottom plate. The clip or saddle, A, is broad at the base to enable it to rest conveniently on the sides of the axlebox, in the manner of an ordinary spring hoop, without interfering at all with the grease chamber.

The deflections of the above spring are by actual experiment.

$\frac{1}{2}$ ton weight,	$\frac{1}{2}$ inch deflection.
1	1
1 $\frac{1}{2}$	1 $\frac{1}{2}$
2	2
3	3
4	4

No permanent set in this experiment.

“On an India-rubber Buffer,” by Mr. de Bergue.

In reference to the observation that the sustaining power of the India-rubber buffers is too great, and that in the event of a collision the train might collapse before this was fully developed—the writer would observe, that the most effective buffers, in the event of a collision, will be those which will oppose the greatest amount of resistance moving through the greatest space, provided their maximum resisting force should not exceed the pressure that could be sustained by the under frames of the wagons without injury. Now the maximum sustaining power of

a pair of these India-rubber buffers does not exceed 20 tons, and as there are several thousand sets of them in use, many of which have at times been driven quite home without the wagons being collapsed, it follows that their resisting power does not exceed a *useful* limit, and that they must consequently be much more efficient in the event of a collision than any other buffers having the same stroke and only one-third of the resisting power.

But it must be borne in mind that buffers are not solely required for cases of collision, they are more generally serviceable to break the slighter concussions in stopping and starting trains and in sidings and warehouses; and in order that they should be appropriate to this service, their resisting force must be comparatively very small at the commencement of the stroke; no spring yet produced combines these properties so perfectly as the vulcanized India-rubber; indeed, it is so easily acted upon at the commencement of the stroke, that it has been found advisable to compress the four rings in each buffer to the extent of one inch before the stroke commences.

If the immense sustaining power of these buffers were objectionable, it could be reduced to any required amount, simply by decreasing the diameter and thickness of the rings, which would also lessen the cost—but, in the opinion of the writer, that would be destroying one of the most valuable properties of these buffers.

A comparison has been made between the relative proportions of effective resistance of a pair of buffers of 12 inches stroke with the ordinary laminated spring, and a pair of the India-rubber wagon buffers; but, in the writer's opinion, the calculations are incorrect. It has been assumed that the India-rubber buffers have only $1\frac{1}{2}$ inch stroke with a final resistance of 3 tons: say $3 \text{ tons} \times 1\frac{1}{2} \text{ inches} = 4\frac{1}{2}$ effective resistance of a pair of India-rubber buffers. Then 12 inches is given as the stroke of the laminated spring with $2\frac{3}{4}$ tons, which would make $2\frac{3}{4} \text{ tons} \times 12 \text{ inches} = 33$ effective resistance, the proportion being $4\frac{1}{2}$ to 33, or 1 to $7\frac{1}{2}$.

But as regards the India-rubber buffers, the length of stroke is exactly 3 inches, and the maximum resistance 20 tons for a pair; and as this large amount of resis-

tance is mainly accumulated towards the end of the stroke (as will be seen from a statement of experiments annexed), it would not be correct to take the half of that as the average resisting power; but it is presumed that it will be keeping within the limits to take only one-quarter of the maximum resistance, say 5 tons, as the average resisting power for a pair of buffers, thus: $5 \text{ tons} \times 3 \text{ inches} = 15$ effective resistance.

With regard to the laminated springs, $2\frac{3}{4}$ tons is given as the resisting power of the spring for the pair of buffers with 12 inches of action; but this $2\frac{3}{4}$ tons is the *maximum* resistance of the spring deflected to a straight line, and being a steel spring, and its resistance not increasing in the same compound ratio as the India-rubber, nearly half its maximum power should be allowed as the average resistance throughout the stroke; say $1\frac{3}{8} \text{ ton} \times 12 \text{ inches} = 16\frac{1}{2}$ effective resistance; thus it appears that the proportionate effective resisting force between a pair of the India-rubber 3 inches stroke wagon buffers, and a pair of 12 inches stroke ordinary laminated spring buffers, is as 15 to $16\frac{1}{2}$, instead of being as 1 to $7\frac{1}{2}$.

It may be here observed that the India-rubber buffers are not limited to 3 inches stroke; some are made $4\frac{1}{2}$ inches, and some with 6 inches stroke for passenger carriages, and their resisting power is proportionately increased, but this incurs additional expense, which is a matter of no small consideration in the present times, and it is found from lengthened practice that the 3 inches stroke buffers are quite sufficient for all classes of goods wagons, and even for cattle trucks, luggage vans, &c. The size of the India-rubber rings in these 3 inches stroke buffers is $5\frac{1}{4}$ inches diameter and $1\frac{1}{2}$ inch thick.

With respect to the durability of the vulcanized India-rubber, a reference has been made to elastic bands for papers that have become completely rotten; but it will be sufficient to state the fact that a great quantity of these bands have been made that were never "vulcanized" at all, and were manufactured under an independent patent for "converting," but they were sold by the same parties, and the public did not know any difference. The India-rubber rings used in the buffers are all vulcanized, and the writer has examined

many of them that have been at work for several years, and he has not yet met with a single instance of a bad one.

It has been objected to the external cylinder buffers, that the piston or plunger is guided through too short a space, which makes it more liable to break the cylinder in the event of an oblique blow; but it should be observed that this defect is obviated in the India-rubber buffer, where the length of the bearing extends from the mouth of the cylinder to the end of the boss on the base plate, the spindle being fitted so as to form a solid body with the plunger. The India-rubber buffer is superior, in the writer's opinion, to the other external buffers, in efficiency and durability, whilst equally compact and economical, as the resistance begins very gradually at the first part of the stroke, and increases to a great power at the latter part, without coming to a dead stop at a moderate pressure, as in the other buffers; the pressure being spread uniformly over the whole surface of the base plate, which is better adapted to preserve the wagon frame from injury, and the elastic material is not liable to break as steel, whether in the form of a spiral or otherwise.

The following table shows the actual compression of one of these India-rubber wagon buffers of 3-inch stroke, with each increase of pressure from $\frac{1}{4}$ ton up to 10 tons, tried with great accuracy in a machine made for the purpose:

Pressure in Tons.	Amount of Action in Inches.
$\frac{1}{4}$	.125
$\frac{1}{2}$	.625
$\frac{3}{4}$	1.063
1	1.344
$1\frac{1}{4}$	1.694
$1\frac{1}{2}$	1.750
$1\frac{3}{4}$	1.906
2	2.031
$2\frac{1}{4}$	2.219
$2\frac{1}{2}$	2.375
3	2.563
4	2.750
5	2.813
6	2.875
7	2.933
8	2.969
9	3.000
10	3.000



Scale, 1-16th.

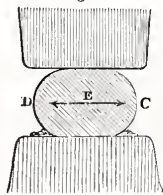
in this country, there are, probably, many of our readers, to whom they will appear new, and they are certainly too valuable to be lost. It is the substance of a paper read before the British Association.

Before proceeding to describe the nature of the improvements in question, Mr. Nasmyth made some remarks on the value and importance of any improvement which tended to increase the certainty of the production of sound and perfectly solid forgings of wrought-iron, more especially those massive forgings required for such purposes as paddle shafts, marine engines, crank and plain axles for locomotive engines, anchors, and such like, on the soundness of which, both life and property to a vast amount may depend.

Mr. Nasmyth instanced cases in which paddle shafts of marine engines had given way, although in the first instance they had all the *outward* aspect of the most perfect soundness, but which on fracture exhibited the existence of original defect, in being little less internally than a mass or bundle of loose bars of iron, which had never been in a sound welded union, but had only been held together by the exterior, where alone the welding had been so far perfect.

Mr. Nasmyth exhibited a diagram, of which fig. 1 is a copy, in order to illustrate the action induced on the centre portion of a cylindrical forging when produced under the action of a flat-faced hammer and anvil.

Fig. 1.

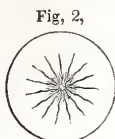


It will be seen at once that the action induced on the centre portion of the metal of a shaft, or such like cylindrical form, by the successive blows of a flat-faced hammer and anvil, as A and B is to cause the work to spread out or extend in the direction E D, E C (as represented by the double pointed arrow on the figure); and as the flattened-out form has to be attempted to be corrected by turning the shaft round and round on the anvil, so that each successive blow may be made to correct the spreading out caused by the previous blow. The result of this action is a

IMPROVEMENTS IN FORGING IRON. By Jas. Nasmyth.

ALTHOUGH these improvements have already been noticed in various journals

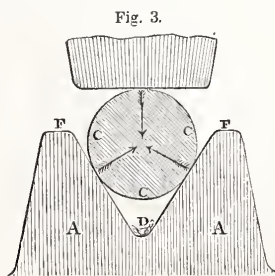
fretting or mincing of the centre part of the metal of the shaft, resulting in a separation of a metal throughout the entire centre portion of the shaft, somewhat after the manner indicated in fig. 2, frequently to such an extent as to permit the passage of air or water from end to end of shafts forged in this manner.



The effect of this kind of unsoundness is, that it is certain, sooner or later, to work out towards the exterior, and in all probability result in "a break down," more or less disastrous in its consequences.

Mr. Nasmyth then proceeded to describe his improved form of anvil-face, by the employment of which all such defects as detailed above are avoided. Such has been the perfect success and excellent results which have attended the use of his improved anvil face, that its adoption has become almost universal; and the production of absolutely sound solid wrought-iron shafts, of whatsoever magnitude, rendered equally easy as certain.

A (fig. 3), represents the form of Mr. Nasmyth's improved anvil-face, which he terms a V-anvil, between the jaws of which the work to be hammered is placed as indicated by a cylindrical shaft, seen in section marked c c c.



A glance at the above figure will, no doubt, render its action evident, namely, that the action of each blow of the hammer, on the work c c c, instead of causing, as in the case of fig. 1, a diverging action on the centre portion of the work, occasions, on the contrary, a converging action, as represented by the three arrows; and instead of having the centre portion of the metal of the

shaft rendered less compact and solid by the action of the blows of the hammer, we have quite the contrary effect produced; besides which, owing to the wedge-like form and action of this V-anvil face, the compressing effect of the blows are most importantly enhanced, and the ease and rapidity with which such cylindrical-formed work as shafts and the like can be produced under or by such means is most remarkable; so much so as to enable the foremen to hammer out *at one heat*, by means of this V-anvil, as much as would require three heats on the common flat-faced anvil. Add to which the vast convenience which the fork-like form of the V-anvil yields in keeping the work at all times right under the centre of the hammer as it is turned round and round to receive the successive blows, which in the case of work of the largest class is a matter of no small trouble; another advantage consists in the free passage or exit which is at all times preserved for the escape of the scales and impurities which fall from the hot iron during the process of hammering, which scales fall down towards the apex of the V at D, and trickle away, thus removing the cause of blemish and roughness which is caused by such scales collecting on the face of the flat anvil, and get beat into the surface of the forging.

It will be seen on inspecting fig. 3, that one such V-anvil face as there represented, will accommodate a vast range of diameters of work—namely, all variety of diameters, such as will neither absolutely rest on the bottom of the apex at D, or on the corners F F.

Mr. Nasmyth has taken every means, by the most free communication, to promulgate among those interested the advantages of this V-anvil, and has been rewarded by seeing its use become almost universal.

Mr. N. stated that an angle of 80° was found by him to be most generally suitable for the inclination of the sides of the V, and also that the edges should be well rounded off, and the surface of the V sides curved in the direction of the *axis* of the work, to the extent of one-eighth of an inch in twelve inches, so as to be "*proud*" in the centre, and so facilitate the extension (axis ways) of the work. The vast simplicity, as well as

the important results, which are yielded by the employment of this V-anvil face, has, in no small degree, contributed to its almost universal adoption. Its employment renders the production of perfect sound work as easy as certain.

Mr. Nasmyth next proceeded to describe the second part of his improvements in forging iron, which consist as in the first case of means equally certain and simple in producing sound boiler plates. Mr. Nasmyth prefaced his description of his improvements on this truly important subject by detailing the nature of the most frequent *cause* of unsoundness in iron forgings generally, and in boiler plates in particular, namely, the imperfect expulsion of the molten oxyd of iron, or "scoria," or "cinder" as it is termed, which in every case of welding hot iron, covers and clings to the surface of the metal; and if left interposing between the welded surfaces, is certain to occasion a defect greater or less according to the surface of junction it occupies. The frequency of this interposing scoria as the *true cause* of unsound forged work was forcibly alluded to by Mr. Nasmyth, and shown to be the most fertile source and cause of the failure of wrought-iron work, resulting as such too frequently does, in the most sad and disastrous accidents, such as the failure of the links of chains and anchors, and in the costly and often distressing results arising from defective, *i. e.* blistered boiler plates.

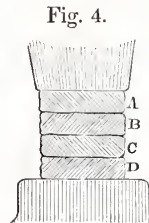
In respect to the links of chains, Mr. Nasmyth mentioned as the result of an extensive series of experiments on the strength of chain cables, on which, as member of "the committee on metals," he was employed by the Admiralty; out of every ten cases of fracture, eight were occasioned by defective welding, as evinced by the appearance of the surfaces which present to a practical eye appearances not to be mistaken, owing to the very peculiar aspect of the surface of the *apparently* welded metal, between which surfaces the oxyd or scoria had not been duly expressed.

Mr. Nasmyth further described the condition absolutely requisite to perfect welding, namely, not merely that the surfaces we desire to weld should be really "welding hot," but also that when brought into contact, no particle of the

scoria, which inevitably clings to the metal while welding hot, should be permitted to remain interposing between such surfaces as we desire to weld. If such material is left interposing, we are certain to have defect and unsoundness to a greater or less extent as the result.

In order the more clearly to detail his improvements on this important subject, Mr. Nasmyth exhibited a colored drawing representing the usual form and arrangement of "a pile" of "slabs" such as are employed in forming, when welded together, a mass of iron from which boiler plates or bars of iron are rolled. Fig. 4 represents such a pile of "slabs," which having been as is generally the case produced under the action of a forge-hammer and anvil, or as is generally the case, slightly convex surfaces, causes the slabs so produced to have certain hollow parts, or slightly concave portions of their surfaces, so that when piled one upon the other, as in fig. 4, the risk of having hollow spaces between is almost certain. The hollow spaces are represented in the figure by the dark irregular lines between the slabs.

Referring to fig. 4, A, B, C, D, represent a pile of four slabs laid on the anvil welding hot; owing to the *concave* irregularities of the surfaces, the parts most certain to come into contact first, are generally the exterior edges of the slabs. The effect of the blows of the hammer is first to weld the parts



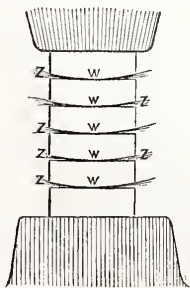
in natural contact; and by continuance of the blows, the interposing scoria or "cinder" is expressed, in a degree more or less perfectly, according to the energy of the blows and the deepness of the convex or hollow patches betwixt the slabs. So long as there exists an exit or passage for this scoria, all is well; but, as generally happens, some portion of this scoria lurks behind after all chance of escape is removed, by the welding of the exterior portion of the surfaces of the slabs. The result of this is, that we have to a certainty a defect greater or less in amount, according to the quantity or surface over which the *inclosed* scoria extends: once such scoria is shut up between the surface of the slabs, no amount

of after hammering will ever expel it, but on the contrary, will only tend to its extension over a larger surface; and, as before said, so long as a particle of this scoria is left interposing, so have we a degree of unsoundness in proportion.

Great as this evil is, and common as it is as a fertile cause of defective iron work, and the more especially so in the case of boiler plates, the means of avoiding such source and cause of defect is as simple as the results are important; and it is to be hoped that the free and open communication which Mr. Nasmyth has made of his views on the subject, will be answered in the most acceptable way by the general adoption of his improvement, or certain means of avoiding the occurrence and existence of all such causes of defective boiler plates, and forged work generally; which improvements consist simply in *so forming the surfaces which we desire to weld together, that a free exit may be preserved to the last, for the escape of the molten oxyd or scoria, until the entire surface of the parts we desire to weld are thoroughly incorporated by the welding property, aided by the action of the hammer or rolls, as the case may be.*

In order to accomplish this most important and desirable object, Mr. Nasmyth forms the surfaces of his slabs *convex* (see figure 5); by which most simple

Fig. 5.



common-sense-means, a perfect free exit to the scoria or interposing impurity is maintained to the last moment, the welding commencing at the centre part of contact *w*, and extending outwards towards the edges, under the action of the successive blows of the hammer, or squeeze of the rolls; but, as before said, an open door is kept for the escape of the scoria, until the surfaces unite *from the*

centre *w* to the outer edge *z, z, z, z*. Here, then, by an arrangement or formation of the surfaces we desire to weld, we have the most certain and simple means of procuring a perfectly solid sound mass of iron, which, when beaten, hammered, or rolled down to whatsoever thickness we desire, will retain, to the last, all the qualities of the one sound solid mass we had converted it into by this most simple improvement—namely, giving to the surfaces we desire to weld a convex form and relation to each other.—Mr. Nasmyth concluded his observations on these important subjects by an earnest appeal to the members of the Mechanical Section to diffuse, by all means in their power, the information which, on this as on all such subjects, he shall ever feel the highest pleasure in communicating to the practical men of his profession, and the world in general, who may think fit to accept these results of an active life, in which he finds so much real pleasure in freely sharing with them.

FORCE OF WAVES.

Observations on the force of the Waves.

Read before a meeting of the British Association. BY THOMAS STEVENSON, F. R.S.E., Civil Engineer.

The author, after some introductory remarks, described the action of the Marine Dynamometer, the self-registering instrument with which the observations were made, and one of the instruments was exhibited. He stated, that a theoretical objection might, perhaps, be started to referring the action of the sea to a statical value, but contended, that in designing sea works, the attempt of the engineer is to oppose the dynamical action of the sea by the dead weight or inertia of the masonry, so that the indications of the Marine Dynamometer furnish exactly the kind of information which the engineer requires. The greatest result registered in the Atlantic Ocean was at Skerryvore, during the westerly gale of the 29th of March, 1845, when the force was 6083 lbs., or 3 tons per square foot. The greatest result registered in the German Ocean was 3013 lbs., or about $1\frac{1}{2}$ ton per square foot. It further appeared, from taking an average result for five of the summer months during the years 1843 and 1844, that the force in the Atlantic Ocean was

611 lbs. per square foot, while the corresponding average for six of the *winter* months was 2086 lbs., or three times as great as in summer. These observations he had communicated in 1845 to the Royal Society of Edinburgh, and were printed in the twelfth volume of the 'Transactions' of that body.

The author then stated, that the greatness of those results had excited surprise in almost all to whom they had been communicated, and positive doubts were expressed by many as to the correctness of the indications. Three classes of facts, essentially different from each other, may be appealed to, as proving that, if the indications of the Dynamometer are incorrect, the error must be in defect, and not in excess. The first fact to which reference was made was, the elevation of spray caused by waves meeting with an obstruction to their onward motion. Most persons are familiar with the frontispiece representations of the Eddystone and Bell Rock Lighthouses during storms, which are attached to the descriptive accounts of the erection of those works; and although some deduction may be allowed for the fancy of the artists, still there can be no doubt they are, in the main, faithful representations of a natural phenomenon. On the 20th of November, 1827, in a heavy ground swell after a storm, solid water rose at the Bell Rock, 106 feet above the level of the sea, irrespective of the depth of the trough of the wave. Such an elevation is due to a *head* of water of the same height. The force, then, which urges the lower courses of the Bell Rock must have been nearly *three tons per square foot*, while the highest indication of the Marine Dynamometer at the same place, since the observations were commenced, hardly *equalled* $1\frac{1}{2}$ ton. The second class of facts to which the author alluded, was the fracture of materials of known strength. The instance adduced was a small harbor in Argyllshire, where, in order to preserve the tranquillity of the tide basin, a contrivance called '*booms*,' well known in harbor architecture, had been resorted to. The booms are logs of timber, which are placed across the entrance to a harbor, and fit into checks or grooves, which are made in the masonry on either side. The booms therefore, act as a temporary wall or barrier against the waves. The set of

booms referred to have been in use for about five years, and in that time the waves have broken no less than four *Memel* logs, measuring each one foot square in the middle, and spanning an entrance of 20 feet. From the known strength of the material, it will be found, that on these four occasions a force must have been exerted equivalent to the uniform distribution of a dead weight of 30 tons, or *at the rate of* $1\frac{1}{2}$ tons per square foot, while the highest result that had been recorded at the same place during the short period that observations were made, was about $1\frac{1}{8}$ ton per square foot.

The last class of effects to which the author alluded, was the movement of heavy blocks of stone. The information derived from such observations was not so certain or satisfactory as from the other instances. The only record he could adduce was the movement of a block of stone *weighing* about $1\frac{1}{4}$ ton, to which a Marine Dynamometer had been bolted. The stone was turned upside down, and the Dynamometer indicated a pressure of *little more than one ton*.

The author then referred to the overturning of the Carr Rock Beacon by the sea in 1817, during a heavy gale, but stated that, as we do not know the manner in which waves act when encountering obstacles, it was impossible to calculate what force had in this instance been exerted. The part of the column which was overturned was 36 feet in height and 17 feet in diameter at the base, the rock being so small as to preclude a greater diameter. The author then concluded by stating the following desiderata, which he thought important:—

1st. Continued observations so as to ascertain *constants* for the Atlantic and German Oceans and the Irish Sea.

2nd. Relative forces of the same wave both above high-water and below low-water levels. And

3rd. Relative forces of the same wave against vertical and sloping surfaces.

MECHANICS FOR THE MILLION—NO. 2.

For Appletons' Mechanics' Magazine and Engineers' Journal.

WORK OF LIVING AGENTS.

Although the laboring force assigned, by Watt, to a horse, 33000 lbs. per minute, has been found by more recent experiments to be considerably too much;

it is still retained by engineers as the unit of a horse power. It is also important to observe, that the laboring force of animals varies very much with the manner in which their muscular strength is exerted; and also, with the rate at which they labor.

The following table (chiefly taken from Morin's *Mécanique Pratique*) shows the greatest amount of effective work which a laborer will perform under the different modes in which he exerts his muscular power

Units of work done by a man per minute, in pounds, raised one foot high.

Duration of labor 8 hours per day.

Raising his own body	4250
Working at the treadmill	3900
Drawing, or pushing horizontally	3120
Pushing and drawing alternately in a vertical direction	2380
Turning a handle	2600
Working with his arms and legs as in rowing	4000

Duration of labor 6 hours per day.

Raising material with a pulley	1560
Raising material with the hands	1470
Raising material upon the back and returning empty	1126

Duration of labor of 10 hours per day.

Raising materials with a wheel-barrow on ramps	720
Throwing earth to the height of 5 feet	470

Useful work of a man, in raising water, by different engines—

Duration of labor 8 hours per day.

With a windlass from deep wells	2560
“ An upright chain pump	1730
“ A tread-mill	3176
“ A Chinese wheel	2167
“ An Archimedian screw	1505
Raising water from a well, with a pail and rope	1054

Examples.

Ex. 1. How many cubic feet of earth, weighing 100 lbs. per cubic foot, will a man throw to the height of 5 feet in a day of 10 hours long?

Work per day = $470 \times 60 \times 10$. (See table.)

Work in raising 1 c. ft. = 100×5 .

$\therefore$ No. c. ft. = $\frac{470 \times 60 \times 10}{100 \times 5} = 564$.

Ex. 2. How many bricks will a man

raise in a day of 6 hours long to the mean height of 20 ft., allowing that the weight of a cubic foot of brick is 125 lbs., and that 17 bricks form a cubic foot?

No. Bricks = $\frac{1126 \times 60 \times 6 \times 17}{125 \times 20} = 2756$.

Ex. 3. How many cubic feet of water will a laborer working with a pail and rope, raise from a well whose depth is 20 feet?

No. c. ft. = $\frac{1054 \times 60 \times 8}{20 \times 62.5} = 404.7$.

Ex. 4. Required the same, as in the last example, when the laborer works at the chain pump?

No. c. ft. = $\frac{1730 \times 60 \times 8}{20 \times 62.5} = 61$.

Ex. 5. How many tons of material would a laborer working at a treadmill, raise in a day of 8 hours from a depth of 80 feet?

Work done per day = $3900 \times 60 \times 8$.
Work in raising 1 ton = 2240×80 .

$\therefore$ No. tons = $\frac{3900 \times 60 \times 8}{2240 \times 80} = 10.4$.

Ex. 6. What weight will the laborer, in the last example, raise per day, when working with a pulley?

No. tons = $\frac{1560 \times 60 \times 6}{2240 \times 80} = 3.1$.

Ex. 7. What would be the cost per ton, in example 8, when the material is raised by two asses, costing 3s. per day? *Ans. 2½d.*

To compare the traction of animals with the rate at which they travel.

The traction, or force with which animals pull, decreases with the increase of speed. The following table, given by Tredgold, shows the relation of speed and traction of a horse.

Rate in miles per hour. Traction in lbs.

2	166
3	125
3½	104
4	83
4½	62½
5	41½

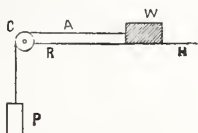
The relation exhibited in this table may be generally expressed by the formula, $t = 250 - 41\frac{2}{3}r$, where t is the traction in lbs., and r the rate in miles per hour. From this formula it appears, that a horse will do the greatest amount

of work when he travels at the rate of three miles per hour.

Work in overcoming the resistance of friction.

When a body is moved slowly along a horizontal plane, the resistance to be overcome is due to friction. It has been found by experiment that this resistance, on a given surface, is a certain proportional part of the weight of the body; and that it is not affected by any change in the rate of the body's motion, or the extent of the rubbing surfaces.

When a cart is drawn along a *very good* McAdamized road, the resistance of friction is about $\frac{1}{30}$ of the whole load, or about 74 lbs. per ton; so that a horse, in order to draw a ton along such a road, must pull with the force of 74 lbs. This is called the traction of the horse. A carriage upon a railway only requires a pressure of $\frac{1}{280}$ part of the weight to give it motion, or about 8 lbs. per ton. The fractions $\frac{1}{30}$ and $\frac{1}{280}$ are called the coefficients of frictions. As the rubbing surfaces become smoother, these coefficients become smaller.



Let w be a weight drawn upon the horizontal plane $H R$, by means of a weight P attached to a cord going over the wheel C ; then the weight P , just necessary to draw w along the plane, will be equal to the resistance of friction. If w be 1 ton, then, in the case of the railway, P will be 8 lbs., and if w be 2 tons, P will be 2 times 8 lbs., or 16 lbs., and so on. Now, whatever distance P descends, the weight w will be drawn along the plane the same distance; hence the work done upon w will be the weight of P in lbs. multiplied by the distance in feet through which it descends,—or, what is the same thing,—the resistance of friction in lbs. multiplied by the space in feet over which w is moved upon the plane.

The work applied to a machine is consumed by the work done, or the useful work, together with the useless work, or the work destroyed by the friction of the parts of the machine. When the work

applied exceeds the work consumed, the redundant work goes to increase the speed of the parts of the machine, which thus acts as a reservoir of work. This motion will go on increasing until the work of the resistance and the useful work are together equal to the work applied, and then the motion of the machine will become uniform. Thus, in a railway carriage, at first the work of the engine exceeds the work of the resistances, and therefore the speed of the engine goes on increasing; but, as the speed increases, the work of the resistances also increases, so that at length the engine attains a nearly uniform motion, which is called the greatest or maximum speed, and then the work destroyed by the resistances will be exactly equal to the work applied by the moving power. It is on this principle that the following calculations are made.

Work in moving a carriage upon a horizontal plane.

Ex. 1. What must be the effective H. P. of a locomotive engine, which moves at the steady speed of 30 miles per hour, upon a level rail, the weight of the train being 50 tons, and the friction 8 lbs. per ton, the resistance of the atmosphere being neglected?

Resistance of friction $= 8 \times 50 = 400$ lbs.

Distance moved in feet per minute $= \frac{30 \times 5280}{60} = 2640$.

Work of friction per min. $= 400 \times 2640$.

Now, as the speed of the train is uniform, the work of the resistances will be equal to the effective work of the engine.

$\therefore$ H. P. engine $= \frac{400 \times 2640}{33000} = 32$.

Ex. 2. An engine of 40 H. P. moves with the maximum speed of 35 miles upon a level rail; required the gross load of the train?

Work engine per hour $= 40 \times 33000 \times 60$.

Work consumed per hour in moving 1 ton $= 8 \times 35 \times 5280$.

$\therefore$ Number tons $= \frac{40 \times 33000 \times 60}{8 \times 35 \times 5280} = 53.5$.

Or thus.

Let x = equal the gross weight of the train in tons, then, work consumed per hour in moving the train $= x \times 8 \times 35 \times 5280$. But because the train is

moving uniformly, the work that is being consumed is equal to the work that is being done by the engine.

$$\therefore x \times 8 \times 35 \times 5280 = 40 \times 33000 \times 60$$

$$\therefore x = \frac{40 \times 33000 \times 60}{8 \times 35 \times 5280} = 53.5.$$

Ex. 3. What work per minute will a horse perform when travelling at the rate of 2 miles per hour?

Here, by the table, Art. 6, the traction = 166 lbs.

$$\therefore \text{Work per min.} = \frac{2 \times 5280 \times 166}{60} = 29216.$$

Ex. 4. If a horse exert a traction of 160 lbs. when moving at the rate of $2\frac{1}{2}$ miles per hour, what gross weight will he draw upon a road whose coefficient of friction is $\frac{1}{20}$, and what work will he perform per minute?

Here the traction is $\frac{1}{20}$ of the load.

$$\therefore \text{Load} = 12 \text{ times } 160 \text{ lbs.} = 17.1 \text{ cwts.}$$

$$\text{Distance moved in feet per minute} = \frac{2\frac{1}{2} \times 5280}{60} = 220.$$

$$\therefore \text{Work done per minute} = 160 \times 220 = 35200.$$

Ex. 5. If a horse draw a gross load of $1\frac{1}{2}$ tons upon a road whose coefficient of friction is $\frac{1}{20}$, what traction will he exert?

$$\text{Weight moved in lbs.} = 1\frac{1}{2} \times 2240 = 3360 \text{ lbs.}$$

Now the resistance of friction, or the resistance which the horse has to overcome is $\frac{1}{20}$ of this weight.

$$\therefore \text{Traction} = \frac{1}{20} \text{ of } 3360 \text{ lbs.} = 168 \text{ lbs.}$$

Ex. 6. In how many days of 8 hours long will a horse whose traction is 160 lbs., transport 12000 cubic feet of material, weighing 200 lbs. each cubic foot, to the mean distance of four miles, on a road whose coefficient of friction is $\frac{1}{20}$, supposing the weight of the cart to be $\frac{1}{5}$ of the gross load, and that the horse travels with the full load at the rate of $2\frac{1}{2}$ miles per hour, and returns with the empty cart at the rate of 5 miles per hour; required also the cost of the transport, allowing 10 shillings per day for the driver and horse?

$$\text{Gross load} = 160 \times 30 = 4800 \text{ lbs.}$$

$$\text{Net load} = 4800 \times \frac{4}{5} = 3840 \text{ lbs.}$$

$$\text{Weight of the material} = 12000 \times 200 = 2400000 \text{ lbs.}$$

$$\therefore \text{Number of loads} = \frac{2400000}{3840} =$$

625.

Time in going and returning with 1

$$\text{load} = \frac{4}{2\frac{1}{2}} \times \frac{4}{4} = 2.4 \text{ hours.}$$

$\therefore$ Time in removing the whole material = $2.4 \times 625 = 1500$ hours.

$$\therefore \text{Number of days' work} = \frac{1500}{8} =$$

187.5.

$$\text{Cost} = 187.5 \times 10s. = \$234 \text{ } 37.$$

MISCELLANEOUS.

PILE-DRIVING BY ATMOSPHERIC PRESSURE. DR. POTT'S SYSTEM.

In a paper on Lighthouses and Beacons, by Mr. G. A. Findlay, published in the last Part of the Transactions of the Society of Arts, there is the following notice of some of the earlier applications of this system:

This beautiful adaptation of atmospheric pressure has been applied to the erection of several beacons in the vicinity of the mouth of the Thames. The first experiment was upon the Goodwin Sands, on July 16, 1845, and an iron tube of 2 feet 6 inches diameter was driven into the sand to a depth of 22 feet, in two or three hours. A gentleman, present at the experiment, which was made by the Trinity Brethren, said, that the facility with which this large iron tube was made to descend could be compared to nothing better than shutting up a telescope. The method of operation is this; the tubes are in convenient lengths, with spigot-and-faucet joints, and one of them being placed perpendicularly, an air-tight cap is fixed to the upper end. This cap communicates with a powerful air-pump, by means of which the air is exhausted from the tube, drawing up the sand or shingle with the water which ascends, and the tube immediately descends from the effects of outward atmospheric pressure. The contents of the tube are then removed by the pump, which readily draws away the sand or shingle with the water which rises during their action, and the exhaustion process is then continued. The upper end of the tube having become level with the surface, the operation is stopped, the cap

removed, a fresh tube is affixed and secured, and the same course pursued, and thus continued, until, with the greatest facility, this great length of tube penetrated what must have been exceedingly hard sand, nearly resembling stone; as was found by Mr. Bush in his erection of a caisson on these sands, as hereafter described.

The practicability of the scheme being proved, several beacons, as before stated, were erected—as on the Buxey, the Shingles, the Girdler, the Margate, and other sands lying in the mouth of the Thames. And in order to test its capabilities on a large scale, a beacon was constructed on the South Calliper of the Goodwin Sands. It consisted of five cast-iron tubular columns, the centre one, like that above described, 2 feet 6 inches diameter, and penetrating the sand to the depth of 31 feet 6 inches; four smaller tubes surrounded it, and were connected diagonally and laterally, by means of wrought iron rods and clips, secured by screws and wedges. The centre column rose $37\frac{1}{2}$ feet above the sand, and was surmounted by a staff and cage, which was $18\frac{1}{2}$ feet above the cap of the centre column. Such was the structure which, on August 26, 1847, was announced to mariners, and which promised so much for stability and to prove beneficial in its application to the general purposes of navigation. But during a severe gale on October 23, following, this beacon disappeared. It was seen perfect a few hours before its destruction, and now not a vestige even of its foundation is discernible. The failure in this instance, however, was no conclusive proof of the correctness or impracticability of erecting a Lighthouse on such a foundation. When the great force of the waves is recollected, and the large surface that was offered to them, compared with that of Mr. Mitchell's pile Lighthouse at Morecambe Bay, it is not surprising that the one should have proved more permanent than the other. The exposed site of the South Calliper Beacon was certainly well adapted to test its stability, before applying it to the purposes of a Lighthouse; and the result has proved that such would be a hazardous experiment in such a place.

Mr. Joseph Cubitt has since adopted this plan with perfect success in the construction of several bridges on the Great

Northern Railway; as has also Mr. Locke in building the bridge over the Thames at Windsor, for the Windsor and Staines Railway; and it is now being followed by Mr. William Cubitt in the construction of the new bridge over the Medway at Rochester, and by Mr. Hemans in the building of another over the Shannon. We extract the following particulars respecting these structures, and Dr. Pott's system generally, from the Minutes of Evidence taken before the Select Committee of the House of Commons on the Westminster Bridge (July 9, 1850).

W. Cubitt, Esq., C.E., M.P., examined.—What dimensions of cylinders are you now using at the Rochester Bridge?—The cylinders are 7 feet in diameter, and in this case I should probably put down cylinders of 10 feet in diameter, so as to make the diameter of one cylinder form the width of one pier, so that a row of these very large cylinders sunk, to 10, 20, 30, or 40 feet, would make a most durable and excellent foundation, and require no coffer-damming at all.

Will you explain the mode of operation by which you drive down, or procure such enormous pressure as to force those large caissons or piles into the earth?—The piles would be in this case, I should say, probably 10 feet in diameter, consisting of hard thick metal hollow cylinders, the bottom edges being quite sharp, and they are in lengths of 9 or 10 feet, turned up upon the lathe so as to go together perfectly air and water-tight, and bolted together one upon another as they go down. The mode of driving them is to have a tight cap of the same diameter on the top of the cylinder similar to the top of a steam-engine cylinder, and when the cylinder is fixed to drive it through the water and through the guides to the bottom perfectly perpendicular. The air is exhausted from the inside of the cylinder entirely, and the pressure of the air as you let on the pressure of the atmosphere drives it down. The pressure of the atmosphere upon a 10-foot cylinder would be equal to a column of water about 25 feet high, which is a great many tons.

You fill in those cylinders with masonry, do you not?—Yes, with solid brickwork.

Can you conceive any more secure mode of laying a foundation than this plan presents?—I do not know a better.

It is exceedingly good, as we have the means of driving them down; and we can do it by two methods, both of which my son has used, both at Huntingdon and at Peterborough. The Huntingdon Bridge is built upon round piles; circular cylinders, one row forming a foundation in the river for one pier, and another row forming a foundation for another pier, making two piers, and the bridge is at work as a railway bridge. At Peterborough they are now completing another bridge in a more difficult situation, and not so good a foundation as the Huntingdon one, and my son proposed, instead of putting down circular cylinders, which did not fill up the whole space of the pier, to make square cylinders, 6 feet square, and drive them close together, so that they have a large 6-foot cylinder sent down to the bottom, filled with brickwork, which makes a solid brick pier, encased in cast iron.

Chairman, You would not in that case use the word cylinder?—No; this is a hollow prism; we have no term for the hollow square.

Sir C. Barrell. Would the square cylinders be as strong as the circular ones?—Quite. They are quite as strong, because they are filled with brickwork; they are strong enough to resist the pressure of the atmosphere when there is a vacuum inside them.

How do you fill them?—By going down into them by a ladder.

Mr. Peto. This mode of construction would admit of making the base of the piers any size that you might require, would it not?—Yes, whatever you pleased.

It also presents this advantage, the piles being once driven, that it would not be necessary to disturb the earth by withdrawing the piles with a dam around them?—Nothing of the kind. At Rochester I should state that I am making piers—there being a great tide there, and subject to a great rise and fall—with two rows to each pier, two rows of 7-foot piles, and in this case I think one row of 10-foot piles would be ample, or two rows of six feet.

Will you state to the Committee what saving you suppose you effect at Rochester Bridge by this mode of construction over the old mode of coffer-damming?—I have a contract going on for making two piers and two abutments, for as small, indeed I think a smaller, amount of money

than it would cost to make coffer-dams in the same place.

In what proportion is the amount less?—Perhaps £2,000 or £3,000 less; the whole contract for the foundations and filling them up will not exceed £25,000 in that large and deep river; coffer-dams for the same work would have cost a great deal more than that.

When you say £3,000 or £4,000 more, do you mean for each?—The coffer-dams for the work to build the bridge in the usual way would have cost several thousands more than the whole work costs according to this plan.

Mr. Peto. Do you mean that the cost of the abutments and piers, completely and perfectly executed, will be less at Rochester Bridge by £3,000 in the aggregate than the coffer-dams would have cost?—Yes; and I think a larger sum than that difference in a tideway like that, where the old bridge formerly stood. Driving coffer-dams is a very difficult business, without reckoning the constant expense of pumping them out for months or years during the execution of the work. And what I would strongly press upon the attention of the Committee is, that the two bridges, the one at Huntingdon, over the Ouse, which is finished and at work, and the other at Peterborough, and immediately going to work, over the Nene, are both built; and the last one, at Peterborough, was built under very difficult circumstances, for when they were driving the first, after having bored the ground, they found it pretty well under the first square tube for the foundations, and they worked till they could go no further; it was not deep enough by several feet; they then pumped out the water and excavated the earth from the inside, and they went down and examined, and they found a stone-floor at the bottom of hard rock, which was some three feet and upwards in thickness. Now there the making of a coffer-dam would have been very difficult. They then bored a hole through the stone and tried how thick it was, and afterwards quarried out the stone in the inside; and they made a square hole, rather more than six feet square, and then drove the square 6-foot pile through it till they got to the proper depth, and they then filled it full of brickwork; then another was driven alongside of it, and another close alongside that,

till they had made a pier of 40 feet long and 6 feet thick; and there was not a coffer-dam used.

How long do you anticipate the erection of Rochester Bridge will take?—I suppose, being a heavy tideway, from about eighteen months to two years.

Charles Fox, Esq., (of the firm of Fox, Henderson, & Co.) examined.—Will you describe to the Committee the mode of construction?—Perhaps the simplest mode of describing it is to say, that instead of using the old-fashioned wooden coffer-dam, which was always a temporary work, we make use of cylinders of iron, which are in themselves coffer-dams, and which remain permanently as a portion of the structure. We adopt various modes of getting them down, but the more general one is this: we have a large receiver of wrought iron, very much like a cylindrical high-pressure boiler, and from that receiver we exhaust the atmosphere, and when we get the cylinder put into its place, just carefully lowered down on to the bed of the river, surrounded by temporary frames of timber, so as to be sure that it shall be kept in a vertical position, we put a cap on the top, having an elastic pipe from the top cap to the exhausted receiver, and we, at the proper time, open the communication between the two, and the pressure of the atmosphere on the surface of the water in the river produces such a rush to fill up the tube, so as to get rid of any vacuum space, that it carries on a constant state of excavation under the bottom edge of the cylinder, from the pressure of the atmosphere on the top. The atmosphere takes care to push down the pile, aided by its own weight, so as to take up any little space that may have been excavated. When this mode was first spoken of, it was treated with a great deal of ridicule, and people naturally said, "Why, if the pressure of the atmosphere will push the pile down, when the pile is down it will not carry more than a weight equivalent to the pressure of the atmosphere;" and a very practical man raised that objection; not a very scientific man, but a man of very great experience; and I said to him, "Now you are quite wrong, for the principle is, that it acts as a sort of excavating process; it is quite true that the pressure of the atmosphere on the top is useful, as it gets

over any little friction on the sides of the tube, so as to enable it to follow into the excavated space, and without that principle we could not push the cylinder down at all." To prove this, we took a 6-foot cylinder, and calculated what the pressure of the atmosphere upon that cylinder would be, and taking the whole pressure of the atmosphere, it amounted to about 30 tons. I had 30 tons of iron rails placed on the top of the cylinder, and the only result was, that it pushed it down about three-quarters of an inch into the gravel, and brought it to a bearing; but it did no more.

Chairman.—Was that upon a cylinder of 6 feet in diameter?—Yes; we then took off the 30 tons of iron rails and put on the cap and opened the communication with the exhausted receiver, and the cylinder immediately descended into the solid gravel 6 feet 6 inches by one impulse.

Having descended only three-quarters of an inch before?—Only three-quarters of an inch; it just pressed it a little into the ground with the dead pressure of 30 tons. We then removed the cap, and put on the top of the pile 100 tons of rails; but we could get no depression, except some three quarters of an inch, which was done by the little compression that you would have from the weight of the edge of the cylinder on the gravel. That is the general mode of sinking these cast-iron cylinders. But as it will be obvious to the Committee, in the event of our meeting with, say, the trunk of an old tree, or a very large stone, we could not proceed any further, and we have had to devise many means of getting over any difficulty of that kind. In the case of the bridge at the Nene, we have had to go through not only a layer or two of gravel, but through 2 feet 6 inches of solid rock, and that rock not lying in a horizontal position, has offered difficulties which, under other circumstances, would be very expensive to overcome. To enable us to get through any unforeseen matter, it is necessary to get into the cylinder and excavate any material that may be within it, and cut through the obstruction; and to do that we have devised a means by which we convert the cylinder virtually into a diving-bell; that is to say, we fix a cap on the top of the cylinder, and the

air-pumps are constructed so that they are, when required, compressing pumps, and we can pump just enough air into the cylinder to make it counterbalance the pressure of the column of water without, by which means we keep the work perfectly dry, and the men can get at it just as well as if they were working in this room.

What is the greatest depth to which you have driven a single cylinder?—I think the greatest depth to which we have driven a single cylinder is about 19 feet; but one has been driven in the Goodwin Sands 65 feet, by the same process.

The Committee understand that the cylinders are not single, but are piled one upon each other to the required depth?—Exactly so; they are generally used in 9-foot lengths; the piles for the bridge at Rochester are of two diameters, they are 6 feet and 7 feet, and they are cast in lengths of 9 feet, with flanges at the top and bottom, which are accurately turned and fitted together, so that they drop on to one another; there is a projection.

The external water will be found to be effectually excluded by such a mode of junction?—Perfectly; we never have a drop through them; they require nothing more than a single coat of paint, and when we use one of the castings we clean the flange carefully and give it one coat of good red lead paint, and put another down upon it, which is prepared in the same way; they never leak a drop.

Do you recommend as a general principle the adoption of a cylinder or of a square form?—Generally a cylinder, for several reasons.

Will you state the reasons?—In the first place, because it is the cheapest form to construct in the preparation of the casting itself; and in the second place, because it is better capable of bearing pressure, and therefore can be cast with a much less quantity of material in it; the object in a foundation being to get the largest bearing surface at the least possible cost; in the third place, because we have found in practice that it is difficult to sink square caissons close together, because, having a very small space between them, one having been sunk, it is very apt to make it difficult to sink an adjoining one; we have no ground between them to work upon.

The Committee understand likewise

that there is round each cylinder a girdle of timber, which is necessary in order to keep the cylinder in its perpendicular position?—Yes; I have made use of piles upon which temporary frames are fixed, and put two rows of what we call wallings, forming a square space, in which the cylindrical pile is placed and driven by means of the pressure on the cap of the cylinder.

Are the Committee to understand that the surface, or the bed of the river, is in the first instance level, in order to receive the cylinder?—Not at all; we deal with it as we find it.

You use no mechanical means, except in the experiment to which you have adverted, of 30 tons and 100 tons of actual weight; you have recourse rather to physical means of exhausting the air and admitting the pressure of the atmosphere?—Yes, because it is so much cheaper. It is a serious job to put 30 tons on to I, pile, whereas a simple cast-iron caa as p have before described, put on the top is so exceedingly easy.

FARTHER APPLICATIONS OF CENTRIFUGAL ACTION TO MANUFACTURING PURPOSES.

(Translated from the *Moniteur Industriel*, for the *Mechanics' Magazine*.)

It is well known that a centrifugal machine has been hitherto employed with much advantage for the drying of textile fabrics and for clarifying sugar; but these are not the only purposes to which it is adapted; for every day new applications of this apparatus suggest themselves, and important problems are solved by its means.

We now learn that one of the most important operations of brewing may be wonderfully simplified by the use of a centrifugal apparatus. It has hitherto been considered exceedingly difficult to reduce the temperature of beer to the degree of coolness requisite; it has been necessary to make use of refrigerators for this purpose, and, notwithstanding all precautions, mistakes not unfrequently happen. It occurred to some English brewers that this difficult cooling process might be effected by means of a centrifugal machine. This idea has been put in practice with complete success. The beer was reduced to the desired temperature by merely passing it through the

machine; and this was effected not only with great rapidity, but also with considerable economy.

Some time back, a M. Gauthier de la Touche, of Paris, endeavored to produce ice by means of a hydrofugal apparatus. He did not succeed in reducing water to the freezing point, but he cooled it to a degree far below that required in brewing beer.

It would be superfluous to explain these results, for every one is acquainted with the effects of a very rapid ventilation, and the centrifugal machines are made to rotate at the rate of 3000 revolutions per minute, and even quicker.

We are further informed that in certain manufactories in Alsace, a hydrofugal machine is used for making starch. When flour is stirred about in water, the different substances range themselves according to their specific gravities (unless prevented by some peculiar circumstance). Now this is precisely the result obtained by the centrifugal machine; starch, being the heaviest substance, separates itself from the others, and is the first precipitated.

The centrifugal machine may also be advantageously applied for classifying grain, seed, or ores, according to their respective densities, or any other substances of different densities, whether liquid or solid, provided that they are not of a cohesive nature, or that whatever cohesiveness they possess may be easily removed.

In fact, the centrifugal apparatus may be applied to so many different manufactures, that it may justly be looked upon as one of the most fortunate and fruitful inventions of modern times.

ON THE SUBSTITUTION OF FLAX FOR COTTON IN THE MANUFACTURE OF CLOTH.
BY G. R. PORTER, ESQ.

There can be little doubt we are on the eve of some important discovery in relation to the manufacture of flax; rumors and hints are constantly reaching us which point to this, and the subject is one just now occupying the manufacturing mind abroad to some extent, and it would be well for our mechanics to have an eye to the matter. The secret appears to be

a method of applying the present cotton machinery, with slight modifications, to the manufacture of flax. The following article on this subject is from the London Mechanics' Magazine:

The fear of being dependent upon foreign countries for the supply of any article of first necessity has often influenced the mind of the public, although the cases can be but very few in which that fear can have any just foundation. It must be evident, upon the slightest reflection, that if the industry and capital of any country have been applied to the production of any article, the market for which is habitually found in some other country, it must be at least as disastrous for the producing country to be deprived of its market as it could possibly be for the consuming country to have its supplies cut off. In point of fact, both countries would necessarily be placed by the interruption in the same condition of distress, since, to be in a condition to deal together, both must be producing and both consuming countries. There are circumstances, however, under which it might be unwise for a country to be willingly dependent upon another for the means of setting its industry in motion, viz., when the causes of the interruption that will operate injuriously are beyond the control of the country of supply; and such a case actually exists in respect of the, to us, all-important article—cotton. Our supply of cotton has hitherto been drawn in very fluctuating proportions from British India, Brazil, Egypt, our West India colonies, and the United States of America. From this last-named country the quantities were for a long series of years in a continual condition of increase. From Brazil our importations have sensibly lessened without any reasonable prospect of future increase. From Egypt the quantities fluctuate violently, and depend greatly upon causes not falling within ordinary commercial considerations. In the British West Indies the cultivation of cotton has for some time ceased to form a regular branch of industry, and it is hardly to be expected that having thus ceased to be profitable when prices in Europe were uniformly at a higher level than they have been for now a long series of years,

the cultivation of cotton to any important extent will be resumed in these colonies. From British India the quantities received depend upon a different set of circumstances, but of such a nature as to forbid any very sanguine hope of great and permanent increase in the shipments. To those who reflect seriously upon these facts, it must appear a matter of grave importance how any continued failure of cotton crops is to be met; and not only so, but also, how a substitute is to be found for the hitherto constantly increasing amount of those crops; for it will not be enough to provide the same amount of employment as before for our continually growing numbers in a branch of industry which, by its ordinary operations, necessarily brings forward those increased numbers. The uneasiness which it is natural to feel under the circumstances here described, has led to the inquiry, as diligently and as carefully as opportunity has allowed, whether some substitute or auxiliary may not be called into action which shall meet the evil that threatens us; and this, it is suggested, may be found in a kindred branch of manufacture—that of flax.

A very few years ago, when first anxiety began to arise concerning the prospects of our cotton manufacture, the resource which has just been named did not present itself. At that time, our linen manufacture had not made the progress by which it is at present marked—a progress proportionally equal to any that has been made at any time in the cotton manufacture. Hitherto we have, in this kingdom, been greatly dependent upon our foreign importations for supplies of flax; and while the law imposed restrictions upon the importation of grain for human food, there existed a kind of moral impediment in the way of increasing our home growth of articles for any purpose not of equal primary necessity. That impediment is now removed; and there can be no reason given why our fields should not be henceforth used for the production of any article that promises an adequate profit to the farmer. It is especially desirable so to apply the productive power of the soil for the supply of articles as indispensable to the support of millions of people as corn itself. An additional inducement to the growth of flax beyond that offered by

other articles, may be found in the fact, that to bring it to the same condition as that in which it is usually imported from foreign countries, calls for the employment of a considerable amount of human labor. There is no part of the United Kingdom in which the flax plant cannot successfully be cultivated; and there is hardly any country where it might not be brought to supply our deficiencies, should such arise. It should not in any degree interfere with the prosperity of the present race of cotton manufacturers if flax were to be substituted in part for the material now employed by them. Some changes are doubtless necessary in order to adapt their present machinery for the spinning of flax, but not to any important extent; and the expense to which the proprietors might thus be subjected would be well compensated during the first year of short supply of cotton that might arise, by the security that they would feel in the future regularity of their operations; assured as they then would be against the irregularity of seasons, or those disturbances which have arisen, and which always may arise, to disarrange their operations, and to interfere with the regular employment of their hands. It would not appear difficult so to order the arrangements of a spinning-wheel or a weaving shed that both flax and cotton might be included within its operations, and that the preponderance in those operations might be given from time to time either to the one or to the other, according to the capabilities of the markets of supply on the one hand, and the requirements of the markets of consumption on the other.—*Athenæum Report of Proceedings of British Association.*

NEW METHOD OF OBTAINING ELABORATE METALLIC CASTINGS.

The most intricate and curious castings we are acquainted with are those obtained in moulds from nature's own works, by imbedding a leaf, plant, &c. in a semi-fluid medium, which when hardened can be dried and raised to a temperature to burn the inclosed object to ashes. But if it were desired to produce, as a casting, a wreath, bouquet, group of animals, birds, flowers, fruits, &c., the artist would be obliged either to aban-

don the task, or to proceed by a very tedious process to obtain as many separate moulds as there were involved parts in the object to be cast. He would never attempt one model, one mould, and one casting.

Now, when engaged on the Duretype, although I was then employing only flat surfaces, a very slight occurrence in the course of experiments which I was then engaged with led me to discover a simple, economical method for obtaining works of art in metals, however elaborate or delicate, provided they had the two indispensable requisites for obtaining castings at all,—continuity of parts, and sufficient thickness for metal to run. In the Duretype I employed a layer of wax on sheet glass; the wax was engraved, and a plaster-of-paris cast was made of the engraved wax. On slightly warming the glass, the plaster and wax left its surface together, presenting a perfectly uniform appearance; and, for a moment, I was perplexed how to remove the wax. A good fire being in the room, I placed the plaster before it; and the wax sank into the plaster, like snow into the earth before the sun,—leaving the now engraved plaster quite sharp, pure, and unsullied, having no waxed or oily appearance whatever, even where the wax was fully one-sixteenth of an inch thick.

Following out the idea which this circumstance suggested, I saw at once that it was only requisite to model any figure in sheet wax, and surround it with plaster-of-paris, or other sufficiently plastic and hardening mould, to produce all that would be requisite for casting, in almost any metal, any subject whatever; direct from the hand of the artist. The plan which I proceed on is this,—Sheets of wax are cut and formed into any required shape, as usual in making wax flowers, &c.,—or, in some cases, wax, or a substitute consisting of stearine and resin, may be moulded or shaped to any particular form; and when the whole is arranged and put together, set up on a board covered with wax, I next take waxed threads to form air-vents, by attaching one end of a thread to the wax foundation, and the other to the loftiest point in the object, most suitable for this purpose,—proceeding to do the same with other points requiring the same attention,—bearing in mind that the plas-

ter mould will have to be turned upside down, and that when dry and warm from a suitable drying oven, the lower ends of all these threads will be uppermost, and can be withdrawn, having shrunk from the loss of wax; which substance will also have been absorbed by every part of the mould,—or, where thick and in quantity, may in part be run out.

As this means of casting will be of utility only in the hands of practical workmen in metals, I do not go into the matter here more minutely. One mode, but a troublesome one, of obtaining such a class of moulds, already known,—by burning out the object, as at first stated—presents some difficulties, affords little choice, and is of very limited application; whereas I should hope that the improvement here suggested will be found generally useful in producing a variety of highly ornamental work of a character hitherto unknown. By using stearine and resin, with perhaps a little Burgundy pitch, a cheap substitute for wax is obtained. In forming wreaths, &c., as no coloring is required, the artist has only to attend to form, dimensions, and general arrangement; unlike the artificial florist in wax-work, who must study every shade of color. This process, too, has many advantages over electrotyping; and may extend that art to coat with the precious metals castings in copper, &c. obtained by the present suggested improvement.—Indeed, I trust these hints will not be too late to enable all who are interested in ornamental casting to add some improvement, by this method, to such works as they may be intending for the Great Exhibition of the present year.

HENRY DIRCKS.

CHEMISTRY APPLIED TO ARTS AND MANUFACTURES.

From the Chemical Gazette.

On the Preparation of Green and Gray Colors from Oxide of Chrome, for Calico Printing. By Dr. W. H. DE KURRER.

Greens, prepared from oxide of chrome, for cylinder printing, were first introduced into Bohemia in 1840, and soon became universally employed in printing establishments; and immediately upon their adoption came also into use the nu-

merous tints of pearly-gray, likewise obtainable from oxide of chrome. Colors prepared from oxide of chrome possess the valuable property of resisting the action both of light and air, acids and alkalies, and may consequently be classed amongst the fast colors. In preparing these colors for printing cotton fabrics, the substances employed are principally chloride and nitrate of protoxide of chrome, and chrome-sulphate of potash or chrome-alum. The chloride of chromium, called also sea-green in the Bohemian manufactories, is employed in the following manner in calico-printing establishments, for the purpose of producing the green oxide of chrome. At the commencement of the process, the green hydrate of oxide of chrome is prepared by first dissolving 4 kilogrms. (about 2 lbs. English) of bichromate of potash in 22 litres (about a quart English) of boiling water. Then, into a boiler or vessel, containing 108 litres of boiling water, 4.5 kilogrms. of pulverized white arsenic are thrown, and boiled for ten minutes; a precipitate will be formed, and must be allowed to settle; the clear liquor is then run off, and immediately mixed with the solution of bichromate of potash, stirring all the time; in a short time the mixture acquires a green tint, and the hydrated oxide of chrome will be formed and precipitated. After being several times well stirred and allowed to cool, the whole is thrown upon a filter of white wool, and the hydrated oxide of chrome remaining on the filter is carefully washed with boiling water. It is then dried, and is ready to be employed for the preparation of the chloride. In order to obtain the latter salt, hydrochloric acid of 22° Beaumé is diluted with water until the acid no longer gives off vapor. It is then heated, and whilst hot, as much of the hydrated oxide of chrome prepared as above is added as will saturate the acid and leave a slight excess of the oxide undissolved. The whole is then left to settle, and the clear liquor is decanted from the undissolved matter. In this state the solution of chloride of chromium still presents some traces of free acid, which would act injuriously upon the fibres of the cotton. To remove this, and obtain the product in a neutral state, potash ley (marking 20° Beaumé) is poured in very gradually un-

til the oxide of chrome begins to be precipitated. The solution of chloride of chromium thus prepared, and which is of a dark green color, is evaporated until it marks 46° Beaumé. After cooling, a coloring matter is obtained from it, consisting of oxide of chrome of the finest green color. This preparation is sold under the name of sea-green. Before this substance (which can be used with greater advantage than any other preparation for printing in green upon calico) was known, the following, amongst other preparations, were employed for obtaining chrome-green:—

1st Preparation.—To a solution of 0.656 kilogram. of bichromate of potash in 3 litres of water add 1.405 kilogram. of hydrochloric acid, and afterwards 0.250 kilogram. of pulverized tartaric acid. By the addition of the tartaric acid the solution acquires a fine green tint, together with a sweet taste. The following proportions have been given for producing the various shades of color required:—

	Kilogrammes.					
Chromate of potash . . .	1.750	2.875	1.000	0.500	0.437	0.375
Hydrochloric acid	3.125	1.625	1.750	1.000	0.937	0.750
Tartaric acid 2.500	1.625	0.500	0.250	0.172	0.187	

All these compounds (which have a slightly acid reaction) are, when used for printing, thickened with starch or wheat flour, gum-tragacanth or other gums; and, to fix the colors, the printed fabrics are, according to the tints required, kept stretched in the air for several days, and then washed; or they are passed through a bath of chalk or of ammonia. This bath of ammonia is prepared with 24 litres of boiling water, 4 kilogrms. of slacked lime, and 2 kilogrms. of hydrochlorate or sulphate of ammonia, and the fabrics are submitted thereto by being passed several times through a machine similar to that used for printing ground colors, a free current of air being kept up to carry off the pungent odor of the ammonia.

2d Preparation.—0.500 kilogram. of bichromate of potash are boiled in 3 kilogrms. of hydrochloric acid until chlorine ceases to be evolved; 0.500 kilogram. of soda, previously calcined, and 0.500 kilogram. of caustic soda ley, marking 14° Beaumé, are then added; and for printing, the liquor is thickened with gum-tragacanth. The piece, when printed and

dried, is passed through a boiling ammoniacal bath, composed of 0.500 kilogram. of caustic lime, 0.500 kilogram. of hydrochlorate or sulphate of ammonia, and 24 litres of water, after which it is well washed, and finally stretched and dried.

3d Preparation.—To a hot solution of 0.656 kilogram. of bichromate of potash in 3 litres of water 0.500 kilogram. of syrup is added, and afterwards by degrees 2 kilograms. of hydrochloric acid, marking 34° Beaumé, which causes this liquor very shortly to assume a green tint. It is neutralized with caustic soda, the color is thickened as in the first preparation, and the printed fabric is finished in the same manner.

4th Preparation.—Nitrate of chrome is prepared for dissolving in nitric acid the green precipitate of oxide obtained by arsenic in the same manner as the chloride is prepared with hydrochloric acid. This green, thus obtained, gives a yellowish tint upon the cotton fabrics.

Printing Sea-green with a Roller.—For cylinder-printing with chloride of chromium, the color must be thickened either with gum-tragacanth or starch. The following is the mode of proceeding:—

1. *Thickening with Gum-tragacanth.*—Take 0.220 kilogram. of gum-tragacanth reduced to very fine powder, which make into a thin paste with alcohol; then cover up the vessel in which this operation is carried on, and leave it to settle for a few hours; after which add 14.250 litres of solution of chloride of chromium, marking 46° Beaumé; leave the whole for from twenty-four to thirty-six hours, merely stirring occasionally, and finally strain it through a cloth. When the color is too thick for printing delicate designs from the cylinder, it is only necessary to add more of the solution of chloride of chromium until the desired consistence is attained.

2. *Thickening with Starch.*—Mix intimately 2 kilograms. of starch with 5 litres of water, boil the mixture to the consistence of glue, let it cool, and add the solution of chloride of chromium, marking 46° Beaumé, until it is of the consistence required for printing.

As gum-tragacanth is of a denser nature than starch, it furnishes bolder and more intense colors than the latter. After printing, the fabrics are stretched on a frame, and left during the night in a cool

place; the next day they are treated with caustic potash ley, marking 2° Beaumé, well aired, pressed as dry as possible, and then laid for about an hour in running water, washed with washing wheels, pressed and dried, and finally submitted to the process for brightening the colors.

After fixing the yellow, green and blue colors by passing them through lime or by immersion in the bath of acid chromate of potash, the operation is completed; the brightest possible green is obtained by passing the fabric through a bath of acetate of copper, as a portion of the green chromate of copper then combines with the chrome green, and heightens its tone. The operation is conducted as follows:—The proper quantity of water is heated, in a suitable vessel, to a temperature of 131° 133 F., 2 litres of a solution of acetate of copper are added, and the printed pieces are passed twice backwards and forwards through the liquor; they are then placed in running water; after which the moisture is pressed out of them, and they are dried. When six pieces have been passed through the copper-bath in the manner described, 2.375 kilograms. of solution of copper are added for each successive piece, and this is continued so long as there are any pieces to operate upon. The salt of copper gives to the green color a peculiar lustre, without having an injurious influence over the other colors present; even the chrome-yellow loses none of its beauty. The acetate of copper is prepared by dissolving 20 kilograms. of sulphate of copper or blue vitriol in 72 litres of water, decomposing by 10 kilograms. of sugar of lead, and using the clear supernatant liquor.

Cylinder-printing with Yellow Designs upon a Green Ground.—Yellow patterns upon a green ground may be produced by printing (after applying the reserve to protect the madder-reds and purples) with the base of lead, and afterwards applying the chrome-green with the printing-roller. Fabrics thus treated are passed through milk of lime at a temperature of 100° F.; they are washed and dried, and then the fast blue, green and yellow colors are printed; the fabrics are again passed through milk of lime, and after being well washed, the yellow and green colors are brought out by a bath of acid chromate of potash.

The preparation of lead for this purpose consists of the following composition:—3 kilogrms. of pipe-clay are damped with 1·780 litre of water, and mixed with 3·560 kilogrms. of gum-water, to which is added 1·440 kilogrmm. of a solution of chloride of zinc. For every litre of this solution, 0·150 kilogrmm. of acetate of lead, dissolved in a small quantity of water, is added before printing.

Cylinder-printing in Green by means of Arseniated Chloride of Chromium.—Shades of green may be obtained, differing somewhat from the ordinary sea-green, by the employment of arseniated chloride of chromium, prepared in the following manner:—In a large earthen vessel a mixture of 4 kilogrms. of hydrochloric acid and 9 litres of water are heated to ebullition on a sand-bath; to the liquor is added 3 kilogrms. of bichromate of potash. When the solution is complete, 3·650 kilogrms. of finely-pulverized white arsenic are introduced in small quantities, in order that the liquor may not rise and overflow. When the arsenic is likewise completely dissolved, the solution is allowed to cool. The clear liquor, when decanted, is kept ready for use.

For immediate use, 1 kilogrmm. of starch and 0·060 kilogrmm. of finely-powdered gum-tragacanth are boiled in 8 litres of water, and the mixture is allowed to cool. Into 8 litres of this thickening mixture, 32 kilogrms. of arseniated chloride of chromium are slowly poured, and when properly mixed, 6·5 kilogrms. of potash ley of 16° Beaumé are added very gradually, stirring briskly all the time. The color appears very thin before the addition of the potash; but it is thereby thickened and rendered suitable for cylinder-printing. The fabrics printed with this preparation are the next day passed through a weak potash ley (heated to 140° F.), to which a small quantity of milk of lime has been added; they are then well washed, stretched and dried.

To produce a fast green color approaching to gray, take 12 litres of green printing color, and 2·375 litres of fast blue prepared from indigo; mix them together, print the fabrics therewith, and next day pass them through milk of lime, wash with clean water, and stretch and dry them as before.

In order to *impregnate* the fabric with

the color by means of the cylinder machine, so as to produce a uniform green ground, mix gradually 71 litres of the solution of arseniated chloride of chromium, marking 55° Beaumé with 6·500 kilogrms. of solution of potash, of 16° Beaumé, diluted with about 15 litres of water; then add 3 kilogrms. of mucilage of gum-tragacanth, and 0·040 kilogrms. of chloride of iron, and 0·067 kilogrms. decoction of logwood, of 2° Beaumé.

REVIEWS.

Practical Mineralogy, Assaying and Mining.

By FREDERICK OVERMAN, Mining Engineer.
Philadelphia: 1851.

The author has some reputation as a skillful metallurgist, and this work presents in a popular form much valuable information. The subject is divided into three parts, as the title indicates, and treated in the following order: DISTRIBUTION OF MINERALS. DESCRIPTION OF MINERALS. ASSAYING OF MINERALS. MINES.

We take from the article on gold (as a generally interesting subject) the following.

GOLD.

It may be wondered why I did not put this article at the head of my list, because it is certainly, at the present time, the most valuable mineral in the United States, representing a greater value than all others combined. As an excuse, I must confess that I have no confidence either in the profitability of the mines in California, or in their permanency. If California slacks a little in its productions, or the iron market improves a little, the balance will turn in favor of iron, as to the value of the yearly production. Minerals which contain native gold, or the regions where gold is washed from the alluvial gravel, are very plentiful; and at the present time more productive in this country than in any other part of the world.

Native gold.—California stands pre-eminent in the production of this precious metal. The gold in these regions is found in its native state, in small grains, in spangles, in crystals so small as to be almost invisible to the naked eye, and also in lumps of ten and twenty pounds weight. These grains of gold are often found to be imbedded in masses of quartz; at other times they are mechanically inclosed by quartz; but in most cases the grains are pure gold, alloyed with a little

silver. The latter admixture diminishes the value of California gold about 15 or 20 per cent. The gold of California is almost exclusively found in the alluvial sands and gravel on the banks of the rivers, and in the valleys traversed by mountain streams. The implement used for washing out the gold is most simple, consisting of an iron or tin pan. When this vessel is filled with sand, immersed in water, and shaken, the gold sinks to the bottom, and the sand, clay, and gravel flow off with the water, or are taken out by hand. It cannot be doubted that a large quantity of gold is lost in this way; but it appears that more perfect machinery is not applicable, because the deposits of gold are spread over a large surface of country, and transportation of machinery is expensive.

There are gold-bearing localities in Virginia and North Carolina, which, if not equal to those of California at present, will be of greater importance in future, and, I predict, more sure and lasting. There is very little gold extracted from alluvial sands and gravel in North Carolina at present. There were formerly alluvial gold diggings in the States mentioned, which yielded as well as the best California placers. Such diggings furnished, some years ago, large quantities of gold. The abundant yield, however, did not last long; the rich deposits were soon exhausted, and the poorer localities did not pay. Most of the gold in Virginia and North Carolina is at present derived from veins by mining. The gold-bearing rock is chiefly a talcose slate; that is, a slate, resembling soapstone, but which does not feel so greasy. This slate is red, and ferruginous at the surface. At a greater depth, it is filled with small crystals of iron pyrites, which are decomposed near the surface, and appear as peroxide of iron, which colors the slate brown, and, in a few instances, yellow. This slate is of various grades of hardness. It is generally softer in Virginia than in North Carolina. In the latter State it is found to be very hard in those places where the ground or rock has been under the influence of more heat than at other places. This slate is a metamorphic rock, and runs in a regular belt, parallel with the Alleghany mountain chain. Its length is at least five hundred miles, extending from Maryland to the south-western extremity of North Carolina. The width of this gold-bearing belt is, in its broadest part, from twenty to twenty-five miles, which is often contracted to two or three miles. Within this belt, the various veins of gold-bearing slate are distributed. Those parts of the vein which are richest in gold, are characterized by small veins of quartz, running parallel with the slate. Where this quartz is want-

ing, not much gold is to be expected. The talcose gold-bearing slate of Gold Hill, North Carolina, is particularly distinguished in this respect; and it may be said that the ores from that mine are the richest of the whole gold region. The direction of the veins is parallel to the general course of the rocky strata or formation; that is, from north-east to south-west; and their inclination, which is also parallel to that of the strata, is from 45° to 90° . This belt of talcose slate extends farther north-east, through Maryland, Pennsylvania, and New-Jersey; but it is changed in its composition. It appears in this extension as mica-slate, and ceases to contain gold. Farther south-west than North Carolina, it changes into feldspar and its relative rocks. The gold in this south-western district is found imbedded in heavy veins of quartz, which appear frequently in this rock, being parallel with its stratification. These veins of quartz are often twenty feet thick and upwards; they are pyriteous, and contain iron, copper, and sulphurets of lead, which are found to be rich in precious metal. The gold-bearing belt, which can be traced in a southerly direction through South Carolina, Georgia, and Alabama, sinks beneath the Mississippi river, and probably rises again to the surface near the Rocky Mountains.

The gold found in the slate of Virginia and North Carolina occurs in exceedingly small grains, often so fine as to be not only invisible to the naked eye, but undiscernible even by the assistance of a strong lens. This is the case even when the ores are worth three or four dollars per bushel. Some veins of the slate region contain coarse gold, in grains as large as the head of a pin, and even larger. These are generally found in veins of quartz, in which the pyrites are concentrated into larger masses. Where the pyrites are disseminated in fine crystals through the mass of the rock, the gold is found to be very fine. In the fresh pyrites the gold is invisible, even if, after separation, it appears to be coarse. By natural or artificial decomposition the gold becomes visible: the pyrites are converted into oxide of iron, and, by the aid of a lens, the gold may be detected, imbedded in the oxide of iron.

Another form in which native gold is found, is in quartz, in which it is imbedded. Solid white quartz, both in veins and in crystals, is found, in which the gold occurs in spangles, plates, grains, and also in perfectly developed crystals. Quartz of this description is met with in Virginia; more perfect specimens occur in North Carolina, and still better in Georgia; but the best quality is found in California. The gold in this form is rather a curiosity than a valuable mineral, for no regular

veins of such gold-bearing quartz have yet been found, which promised good results.

Gold never appears in solid veins; it is always disseminated through the mass of the rock, in some places more dense than in others. There are localities in the gold region of the Southern States, where every piece of rock, every handful of soil, contains more or less of the precious metal. Gold is never found in secondary strata or the coal regions. We may look in vain for it on the western slope of the Alleghanies; it cannot be there. Its origin appears to be in primitive rock, or granite; but it is most abundantly found in the trap rocks, or those of igneous origin. The geological formation of California is of this character; but that of the gold region of the Southern States is not. In the gold-bearing strata of these States we find trap-rock frequently intruding, but it is not the matrix of the gold. Greenstone-porphry, syenite, and gneiss, appear to be the primary sources of gold. These are also found in dikes and veins in the gold regions. The immediate matrix of gold in these regions is evidently the pyrites, which, however, may be a secondary inclosure. This opinion is supported by the fact that the richest gold ores are found near a vein of trap-rock or other igneous strata.

It is the general impression, when gold is found in the bottom of a stream or near its banks, or in alluvial soil, that a vein of gold ore must exist somewhere above that place, where the gold is found. This impression, however plausible, is fallacious. We find gold in grains disseminated through granite, and also meet with gold washings in the alluvial deposits of granitic mountains; still, there are no gold-bearing veins found in this rock. Transition rocks contain also spangles and grains of gold, but more commonly veins, in which the gold is associated with quartz or calcespar, but most frequently with pyrites. The primary source of gold is evidently in granite or its associate rocks; and the presence of coarse gold in the igneous or volcanic rocks may be attributed to a coagulation of the small particles in its primary sources. These particles belong to the mass of the rock, and not to veins located in it. The veins found in these rocks must necessarily be of an origin secondary to the rock itself; and, as such, have been either infiltrated from above or injected from below. The infiltrated veins can only consist of quartz, feldspar, calcespar, and similar infiltrations, which may include gold accidentally washed into the fissures of the rock. Pyrites and all other sulphurets of metals are injections from below; these cannot crystallize from a watery solution. These sulphurets have been driven

into the crevices of the rock, either in the form of vapors,—which is most probable,—or have been injected in masses by pressure from below. It appears, then, from the foregoing remarks, that we are not justified in supposing veins of gold to lie in the neighborhood of the alluvial deposits where that metal is found. On the contrary, such a supposition appears quite improbable; for the gold from pyriteous veins—the true source of that metal—is generally very fine, and is most likely to be carried off by the waters. It is an observed fact, that where the gold in the alluvial washings is coarse, the chances are, that there is no regular vein of gold ore near. Coarse gold is mostly found to have been distributed through the mass of the rock. Where the streams contain more gold after heavy rains and freshets, it is an indication of there being no veins whence the gold is derived; the abrasion of the rock furnishes the metal. Where the gold in an alluvial deposit is found in a stratum, it is an indication of there being no vein. A severe winter or a heavy freshet is the cause of the formation of this stratum. A vein would furnish a regular supply, not form a stratum. Gold is never carried far from its original resting-place; therefore a vein cannot be found at any considerable distance from the alluvial washings. There is no prospect of finding it where the river ceases to carry it, either above or below.

The quantity of gold derived from this source may be very promising at first, but its future continuance is quite doubtful. There are circumstances which indicate the origin of the California gold to be in the masses of the rock; and it may be well for our Californian friends to pay some attention to these facts.

The next deposit and source of gold may be found in the infiltrated veins. Gold inclosed in crystallized quartz is evidently derived from alluvial soil, which has been washed into the crevices of the rock, and afterwards covered with quartz in solution; and to this result the heat of a volcanic region has no doubt greatly contributed. Silix is easily soluble in pure hot water, but is precipitated from it as soon as it comes in contact with any other matter, or when cooled. The crevices of the feldspathic rock of North Carolina are chiefly filled with crystalline quartz, which in many instances contains gold. This quartz is evidently the result of infiltration; and all the veins of this kind must be uncertain in their duration and extent.

The veins injected from below are a third source of gold. To these belong the pyriteous veins, and, as far as their decomposition is concerned, the ferruginous veins. Whether the gold in these veins is in a metallic form,

and has been evaporated in that state; or whether the gold was raised and condensed along with other metals and sulphurets, is a question of no importance. It may be asserted as a fact, that all native sulphurets, particularly all the sulphurets of iron, contain gold. It does not follow from this that all pyrites contain sufficient gold to pay for its extraction. As sulphurets cannot possibly penetrate any rock but from below, we may naturally conclude that the heaviest body of such kind of ore must necessarily lie deep in the earth. This conclusion is supported and confirmed by practice; for all pyriteous veins are invariably found to improve in quality and quantity with the depth. This circumstance speaks very favorably for the gold formation of the Southern States. We have here a belt of gold ores of unparalleled extent, immense width, and undoubtedly reaching to the primitive rock, which, on an average, cannot be less than two thousand feet deep. Here is a mass of precious metal, inclosed in the rock, which cannot be exhausted for ages; and in this respect the region in question is the most important of all the known gold deposits, California not excepted.

From the foregoing considerations we may conclude that the sources of gold decide the value of a mining district. The gold derived from the abrasion of rocks, where the metal is promiscuously disseminated, is the cheapest, if in sufficient quantity, and coarse, as is the case in California. The first miners who arrive at a virgin deposit may make a fortune in a short time; but, when the gold at that spot is exhausted, there is no vein to fall back upon. It requires a series of years, perhaps ages, to accumulate another heavy deposit of metal. If the washings in such districts are not carried on too extensively, a regular yearly supply may be depended upon; the crop being in proportion to the quantity of rain which has fallen during that period.

The yield of gold from its ores is very variable. In alluvial deposits, a fortune may sometimes be seen in a bucketful of sand. California and North Carolina have each furnished lumps of native gold worth upwards of six thousand dollars. The gold ores of the Southern States—that is, the ferruginous slate, either oxidized or pyriteous—yield from ten cents to one hundred dollars per bushel or one hundred pounds of ore. Oxidized ore which yields fifteen cents' worth of gold per bushel, pays very well for extracting. A profitable business is done with such ore in North Carolina. Ores which yield but ten cents' worth to the bushel are worked to advantage. Most of the mines, however, yield from twenty-five to thirty cents' worth of gold per hundred pounds or bushel of ore. At Gold Hill, North

Carolina, the ore yields, on an average, one dollar per bushel.

If the inexhaustible quantity of the gold ores in the Southern States is considered, and their capability of paying at least the expenses of extraction and profits on investments, it may be said that the poor ores of that region are ultimately the most profitable to the miner. In crushing, washing, and amalgamating these ores, a large portion of gold is wasted, which in poor ores amounts to 50 per cent. Ores which yield twenty cents' worth of gold by amalgamation, yield forty cents by smelting them. The undecomposed ores are troublesome to work. The way adapted to obtain all or most of the gold is, to amalgamate the ore at different times, with intervals for decomposition by exposure to the air.

Report of Commissioners appointed by command of her Majesty to inquire into the Application of Iron to Railway Structures. (Presented to both Houses of Parliament. 1849.)

Iron applied to Railway Structures. By G. D. DEMPSEY. 1849.

Continued from page 184.

In the *Third Series*, comprising ten experiments, the bars employed were 9 feet long between supports, 4 inches broad, and 1½ inch deep, being calculated to break with the same statical pressure as the bars used in the *Second Series*, but being more flexible. The statical breaking-weights were 3968 pounds, and 4332 pounds; the greatest observed deflection (produced by 3968 pounds), 4·56 inches, and 3·96 inches. By giving to the load a velocity of 15 feet per second, the breaking-weights became 3296 pounds, and 3303 pounds; maximum observed deflection 4·85 inches. With a velocity equal to 29 feet per second, the breaking-weight was reduced to 2670 pounds, and the maximum deflection was 4·14 inches. At 36 feet per second, a load of 2176 pounds broke one of the bars in one experiment, and 2060 pounds broke both the bars in another experiment: greatest observed deflection 3·88 inches. At 43 feet per second, 1778 pounds broke both bars, the greatest deflection being 1·54 inch.

In the *Fourth Series*, comprising four ex-

periments, the bars used were of Clyde iron (No. 3), 9 feet long, 2 inches broad, and 3 inches deep. The statical deflection produced by 1120 pounds was .16 and .17 inch; statical breaking-weights 9882 pounds, with ultimate deflection of 1.91 inch, and 9882 pounds, with ultimate deflection of 2.33 inches. With a velocity of 43 feet per second, a load of 3614 pounds produced a deflection of 1.54 inch (the statical deflection of 3643 pounds being only .61 inch), and a load of 2996 pounds produced a deflection of 1.14 inch, while its statical deflection (as proved by bringing it again to a state of rest), was only .52 inch.

Three Series of experiments were conducted on bars 9 feet long between the supports, showing the amount of deflection obtained when the weight is brought on suddenly without impact, and also the breaking-weights. The results are as follow:—*First Series.* Bars of 9 feet long, 1 inch broad, and 2 inches deep. Mean weight of bars, 66.5 pounds.

Velocity in feet per sec.,	0	15	24	29	33	36
Mean breaking-weight						
in lbs. pr. pair of bars,	2281	1842	1523	1216	1213	1176

Second Series. Bars, 9 feet long, 1 inch broad, and 3 inches deep. Mean weight of bars, 93.5 pounds.

Velocity in feet per second,	0	15	29	36	43
Mean breaking-weight in lbs.	4235	3400	3044	2406	2182

Third Series. Bars, 9 feet long, 4 inches broad, and 1½ inch deep. Mean weight of bars, 195 pounds.

Velocity in feet per second,	0	15	29	36	43
Mean breaking-weight in lbs.	4150	3299	2670	2118	1708

Experiments on Railway Bridges to ascertain the increase of deflection produced by the velocity of the load.

The only actual trials of bridges which the Commissioners made to determine the effect of velocity in augmenting deflection, were upon two bridges erected upon the Croydon and Epsom, and South-Eastern Railways, and known as the "Ewell Bridge," and the "Godstone Bridge," each of which supports the railway over a road.

"A scaffold was constructed, which rested on the road, and was therefore unaffected by the motion of the bridge, and a pencil was

fixed to the under-side of one of the girders of the bridge, so that when the latter was deflected by the weight of the engine or train, either placed at rest or passing over it, the pencil traced the extent of the deflection upon a drawing-board attached to the scaffold. An engine and tender, which had been in each case liberally placed under our orders by the directors of the companies, were made to traverse the bridges at different velocities, or rest upon them, at pleasure. The span of the Ewell Bridge is 48 feet, and the statical deflection due to the above load rather more than one-fifth of an inch. This was slightly but decidedly increased when the engine was made to pass over the bridge, and at a velocity of about 50 miles per hour an increase of one-seventh was observed. As it is known that the strain upon a girder is nearly proportional to the deflection, it must be inferred, that in this case the velocity of the load enabled it to exercise the same pressure as if it had been increased by one-seventh, and placed at rest upon the centre of the bridge. The weight of the engine and tender was 39 tons, and the velocity enabled it to exercise a pressure upon the girder equal to a weight of about 45 tons."

Ewell Bridge (Epsom and Croydon Railway). Span 48 feet. Two girders to support each line of rails. Depth of girders at centre, 3 feet 6 inches. Width of bottom flange, 20 inches; thickness of ditto, 3 inches. Weight of two girders, 20 tons. Weight of platform between these girders, 10 tons. Total weight of half the bridge, 30 tons. Weight of engine, 25.2 tons; weight of tender, 13.8 tons. Total, 39 tons.

Velocity in feet per sec,	0	25	30.9	32.3	53.7	75
Deflection in decimal						
parts of an inch, . . .	.215	.215	.230	.225	.245	.235

The Commissioners remark, that "the deflections do not increase steadily; but this could hardly be expected, from the many causes of disturbance."

Godstone Bridge (South-Eastern Railway). Span, 30 feet. Three girders support the roadway. Depth of girders at centre, 3 feet. Width of bottom flange, 15 inches; thickness of ditto, 2½ inches. Weight of two girders, 15 tons. Weight of platform between these girders, 10 tons. Total weight of half the bridge, 25 tons. Weight of engine, 21 tons; weight of tender, 12 tons. Total, 33 tons.

Velocity in feet per second, ... 0 22 40 73
Deflection in decimal parts of an inch, '19 '23 '22 '25

The remainder of *Appendix B* consists of records of some miscellaneous experiments, comprising a series, made by statical pressure, on the strength of rectangular bars of cast iron, and others with the cam, &c., by Capt. H. James, R. E., F. R. S. The records of these experiments are tabulated, and the actual mean reduced breaking-weights shown in juxtaposition with the calculated breaking-weights as obtained from Barlow's formula—

$$s = \frac{l w}{4 a d^2} = 7620,$$

and from the formula given in Hodgkinson's edition of "Tredgold:"

$$w = \frac{4.5 \times b d^2 s}{l}$$

the value of s having been obtained by these writers from the breaking-weights of each kind of iron, in bars 1 inch square, and 4 feet 6 inches long. This comparison distinguishes the kind of iron experimented upon, and confirms the value of mixing and remelting in order to obtain the strongest quality of metal. This table is valuable as showing how far dependence may be placed upon calculations of the strength of iron as deduced from experiments made on a small scale.

The experiments made with the cam, &c., were devised to ascertain the effect produced upon iron bars by reiterated strains, corresponding to loads equal to some fractional part of the breaking-weight. The cams were worked by steam machinery, and the bars depressed and restored to their original position for a great number of times. Two cams were employed, one of which imparted a highly vibratory motion to the bar during the deflection, the other gently depressed the bar, and suddenly released it when the full deflection had been obtained. From 4 to 7 depressions were made per minute. Three bars tested by the former apparatus to a deflection equal to one-third of the statical breaking-weight obtained from similar bars, suffered 10,000 depressions, and afterwards required as much weight to break

them as similar bars subjected to dead weights only. Of two bars subjected to a deflection equal to that due to half the breaking-weight, one was broken by 28,602 depressions, and the other sustained 30,000, and did not appear thereby weakened in its resistance to statical pressure. Of the bars tried with the second cam, three sustained 10,000 depressions, each giving it a deflection equal to that produced by one-third of the statical breaking-weight, without suffering any apparent loss of power to resist statical pressure; one broke with 51,538 depressions; and one bore 100,000 without any apparent loss of strength. Three other bars, defective by the same cam to one-half the extent liable to be produced by the statical breaking-weight, broke with 490, 617, and 900 depressions respectively. *"It must, therefore, be concluded, that iron bars will scarcely bear the reiterated application of one-third their breaking-weight without injury."* A bar of wrought iron 2 inches square in section, and 9 feet long between the supports, was subjected to 100,000 depressions by means of the first mentioned or rough cam, each depression producing a strain corresponding to about five-ninths of the strain that permanently injured a similar bar. These depressions only produced a permanent set of .015 inch. Three wrought iron bars were subjected to 10,000 depressions each, from the step cam, depressing them through 333 in., 666 in., and 833 in. respectively, without producing any perceptible permanent set. A bar, depressed through 1 in., obtained a set of .06 in. and one depressed 300 times through 2 in.; acquired a set of 1.08 in. The largest deflection which did not produce any permanent set, appears, by an experiment on a similar bar, to be that due to rather more than half the statical weight which permanently injured it. A small box-girder, of boiler-plate riveted, 6 in. $\times$ 6 in. in section, and 9 feet long, was also subjected to depressions by means of the rough cam, principally with the view of ascertaining whether any effect would be produced on the

rivets by the repeated strain; but a strain corresponding to 3,752 lbs., repeated 43,370 times, did not produce any appreciable effect.

Of the evidence given by the several witnesses, it is impossible, within our limits, to present any useful abstract.

The several appendices, accompanying the Report, contain very interesting experiments by Mr. R. Stephenson, Mr. Rastrick, Mr. Fairbairn, Mr. Barlow, and others, some of which are to be esteemed as useful accessions to the records of the properties of iron; and we heartily recommend it to "the profession" as the best work of the kind in print, and a valuable auxiliary to our present stock of knowledge on this most important subject—the properties of iron.



Universal Dictionary of Weights and Measures, reduced to the Standard of the United States. By J. H. ALEXANDER. Baltimore, 1850.

This is a work which cannot be too highly commended, whether we regard it in a commercial or scientific point of view. It is the result of much labor and careful research; and such of our readers as are acquainted with the writings of this Author, need not be told that this work is strictly authentic and reliable.

The weights and measures of all countries are arranged for easy reference alphabetically, and their values given in the standard measure of the country.

We quote the first and last paragraphs from the Author's Preface:—

"The chief materials of the following work have been gradually accumulated during researches which from time to time, for several years, I have occupied myself in making upon weights and measures. These researches have been principally in an historical aspect; and the materials themselves were collected to serve for my own use as a guide in detecting and, in the absence of other proof, of proving the migrations and commerce of different nations and at different periods.

"But when they had grown to nearly their present bulk, it occurred to me that

their publication in a shape somewhat like the present, might be useful; not only to those whose tastes and studies were like my own, and whose investigations might thus come to be helped by my labor, but also to others who might find them of convenient reference and application in ordinary concerns of business or education.

"I believe it will be admitted, too, that the aim under which the materials for this book were collected, does not fit it the less (but rather the more) for practical utility, than if it had been set about originally for that special end. The historian who is seeking to trace the footsteps of civilization through the dusky forest of antiquity and the tumultuous and disturbed fields of more modern times, has as much motive for fastidious accuracy as if he was calculating the premium of an actual bill of exchange; the systems upon which weights and measures have been combined, and out of which their various values grow by multiplication and subdivision of the unit, are for him of interest not only as a means of deriving those values, but in their arithmetical proportions as indications of the influence of race and the effect of national habitude; and in the terminology and the very orthography of names, too generally neglected or slurred over by the mere cambist, he looks for, and finds sometimes, a thread to guide him through the maze. In attention to these particulars, the present work will be found, I hope, unless by accident, unexceptionable.

"Finally, if I may be allowed in connection with this work and its appropriate applications, to allude to certain dreams of my own (as they may be; although I consider them capable, without undue effort, of a more prompt and thorough realization than seems to be ordinarily anticipated) as to the prevalence, some day, of an universal conformity of weights and measures, I must acknowledge, that such a result was one of the ends I had in view in the original collection of materials. Not, that such a work was going to show more emphatically than business men feel and reflecting men know, the importance of such an universal conformity; or that a book, whose pages deal in discords, could of itself produce unison: but that the first step to any harmonious settlement is to see clearly and at a glance where the differences lie, and what they are. If a millennial period for this world is ever to come, as many wise have deemed and pious prayed, it must be preceded by one common language and one common system of weights and measures as the basis of intercourse. And the way to that is to be built, not by the violent absorption of other and diverse

systems into one, but rather by a compromise into which all may blend. When the earth in her historical orbit shall have reached that point (as it stood ere mankind were scattered from the plain of Shinar) and not till then, may we begin to hope that her revolutions will be stilled, and that before long the weights and measures of fleeting Time will be merged and lost in the infinite scales and illimitable quantities of Eternity."

PATENTS.

List of Patents (with claims annexed), which issued from the United States Patent Office from the 25th day of February, 1851, to the 4th March, 1851, both inclusive.

7945. *For Improvement in Knitting Machines.*—JOHN PEPPER, of Portsmouth, N. H., Assignor to Charles Warner and Horatio G. Sanford, of Boston, Mass. Antedated August 25, 1850. Dated Feb. 25. "I claim as my invention the following improvements: My first improvement consists in the manner of producing the upward and downward motion of the lead-sinkers and the jack-sinkers, so far as they move simultaneously; and I claim the half-jack vibrating on the comb-bar and connected with the sinker frame, and with the movable cross-bar, and springs for the purpose of depressing the tail ends of the jacks, and thereby raising their forward ends with the jack-sinkers. I also claim the movable cross-bar containing the springs, connected as aforesaid. My second improvement consists in the manner of producing the backward and forward motion of the jack and lead-sinkers; and I claim the cams in combination with the cross-bar with the projections thereon, the hanging bars vibrating on pivots, the comb-bar, and the half-jack, connected with the sinker frame. My third improvement consists in the manner of moving the carrier needle and slur knob; and I claim the combination of the cam, and the slur and shoe plate. I also claim the combination of the cam with the shoe, the movable shoe plate, the chains, the semicircles and hubs, or wheel and hub, the bar connected with the slur carriage, and the slur knob, and the horizontal bar, the carriage connected with the carrier needle. My fourth improvement consists in the manner of moving the ribbed work attachment, and producing the ribbed stitch, simultaneously with the plain stitch, without the machine slide, and with one presser; and I claim the combination of the cams with the levers connected with the frame, and with the ribbed needle-bar; also the same in combination with the presser connected, moved and operating as aforesaid."

7946. *For Improvement in Cooking Ranges.*—MOSES POND, of Boston, Mass. Dated Feb.

25. "What I claim as my invention, is the improvements by which the hot water back is connected with the plate, and by means of which, said hot water back may be either readily removed at any time, or applied in such manner, that the directions of its water-pipes may be disposed so as to accommodate the bath boiler, into which they are usually led, on whatever side of the range the said bath boiler may be placed, the said improvements consisting, *first*, in a connecting piece and the attachments of it and the hot water back, the whole being made to operate together; *second*, in a second set of attachments (fixed in the opposite face of the water back), in combination with the first set thereof. I also claim the peculiar arrangement of flues, which lead the smoke and volatile products of combustion directly around the oven; the said arrangement of flues causing the heat to course against one-half of the bottom of the oven, next into another flue, which takes it backwards and against the other half of the bottom of the oven, thence up a flue against the back of the oven, thence, through a flue extending over and against half of the top of the oven; thence into and through another flue, which carries it backwards and over and against the top of the oven, and conveys it to the chimney, or discharge flue, not meaning to include in such arrangement, the radiating chamber or space. And I also claim the two recesses and two flue plates applied to the plate, in combination with the two valve openings, their damper and cam plate, as applied to the top plate of the oven frame, and used under an arrangement of oven flues, the same allowing of the adaptation of the oven to either side of the fire place, or the use of two such ovens and their frames, in connection with the fire place. I also claim the improvement by which the oven can be raised and readily removed, and by which the smoke is prevented from passing underneath the partition which separates the flues on top of the oven, the same consisting in the sliding or gravitating plate, affixed to the partition."

7947. *For Improvement in the Bellows for Musical Instruments.*—MARVIN SMITH, of New-Haven, Conn. Dated February 25. "What I claim as my invention, is the method of making, or constructing the *Wind Chest* commonly used in Seraphins, Melodcons, and all similar musical instruments with one or more sides made of *Gum Elastic*, or other elastic material, and in such way, and manner, as to be capable of expanding and contracting, or of being increased or diminished in size—and with the aid of metallic or other springs, to answer all the purposes of the common bellows generally used in these and similar instruments."

7948. *For Improvement in applying friction rollers to Hubs and Axles.*—JOSEPH B. WILSON, of Townsend's Inlet, N. Y., and STACY WILSON, of Philadelphia, Pa. Dated February 25. "What we claim as our improvement in the method of applying friction rollers to the axles of wheel carriages, is the interposition between the bearing of the axle and the faces of

the friction rollers, of a loose sleeve, through which the axle is free to slide endwise, while it at the same time carries the sleeve round with it in its rotation, the sleeve having a groove in its outer periphery, to receive the friction rollers, and prevent them from moving endwise the collar."

7949. *For Improvements in Planing Machines.*—JOHN D. BEERS and ISAAC WINSLOW, of Philadelphia, Pa. Dated Feb. 25. "What we claim is, first, the combination of the shifting bed plate with the planes; the planes presenting any desired part of their edge for cutting the surface of the board, after the tonguing and grooving has been performed by the circular saws. We also claim the rotating arms, with their cover, combined with the plane."

7950. *For Improvement in Electro-Magnetic Engines.*—THOMAS C. AVERY, of New-York, N. Y. Dated Feb. 25. "The nature of my invention consists in the combining in pairs, four or more electro-magnets, so as to present their poles towards a common centre, and having space enough intervening between the poles of the magnets for an axis. This axis is connected with one of the poles of the battery, so as to be a part of the galvanic circuit, and is supported at its two ends on the frame of the machine, so as to allow of revolving freely by the action of the magnets on the levers attached to the axis. At the points where the ends of the magnets approach the axis, pieces of brass or other non-magnetic material is interposed to prevent the ends of the magnets acting upon the axis. On each side of these collars of brass, and of sufficient distance apart, are arranged on the axis arms or levers of the first order, between each two of which, the ends or legs of the magnets are allowed to pass, and on which they exercise their attractive force alternately, as the cams on the end of the revolving axis break and close the circuit through the opposite pairs of electro-magnets. I claim the use and manner of arranging the helices and poles of the electro-magnets, in combination with the revolving bars, or sets of bars; that is to say, the helices being upon the bends of the magnets, from which the poles of the magnets extend, towards and near to the centre of motion and the revolving bars, or armatures, extending outwards from the centre of motion and embracing the poles of the magnets successively, as it rotates, for producing a magnetic multiplying power engine."

7951. *For Improved Connection for the Beams and Columns of Iron Buildings.*—JOSEPH BANKS, of New-York, N. Y. Dated Feb. 25. "What I claim therein as new, is the method of securing together the beams and columns of cast-iron fronts for houses, by means of the lugs with their flanges on the upper and under sides of the ends of the beam, and the projections on the inside at the top and base of the columns."

7952. *For Improvement in Sad-Irons.*—EDWARD CLAPP and GEORGE ALDEN, of Dedham,

Mass., Assignor of Edward Clapp, of same place. Dated Feb. 25. "What I claim as my invention, is the improvement in the construction of the bottom of the polishing iron, the same consisting in making it with ridges or projections and concavities."

7953. *For Improved Double-Acting Spring Hinge.*—THEODORE F. ENGELBRECHT, of New-York, N. Y. Dated Feb. 25. "I do not claim the 'combination of an adjustable carved inclined plane with a portion of a hinge, and an adjustable bearing roller with the other portion of the hinge,'—but what I do claim as new, is the manner of combining the helical springs with the cylindrical rotating tumbler and cylindrical sectional case, so that by the rotation of the cylindrical tumbler the heart-shaped projection will be made to traverse over the inclined plane, and cause the tumbler to rise and fall, and thus compress and expand the helical springs lengthways their coil, and simultaneously therewith, wind and unwind said helical springs around the spindle, and thus cause them to act (by the motion of the door in either direction) by torsion and expansion, to close the door when it shall have been opened."

7954. *For Improvement in Extension Tables.*—FRANCIS HOGUET, of Philadelphia, Pa. Dated Feb. 25. "What I claim therein as new and of my invention, is the arrangement of a screw or other equivalent device, in combination with the slide, in such a manner that a screw or its equivalent, of sufficient length to move out one pair of slides, will move out any number desired."

7955. *For Improvement in Cooking Stoves.*—WILLIAM LOURS, of Mt. Jackson, Va. Dated Feb. 25. "What I claim as new therein, is the transverse partition in combination with the arrangement of front and back flues, for causing the several currents to unite after having traversed courses of nearly equal length."

7956. *For Improvement in Machinery for turning irregular forms.*—ALEXANDER LANE, of Killingsworth, Conn. Dated Feb. 25. "I do not claim merely the employment of two or more cutter wheels, or cutter shafts, or cylinders provided with any number of cutters of any required form for cutting the whole surface of, and forming articles of any irregular form, without the use of the model of the article to be formed. But I claim this only, when the cutting cylinders are sustained, revolved, and carried to and from the block to be turned by a revolving cylinder, in whose periphery they are placed, without any longitudinal motion, while the block revolves slowly without any longitudinal or lateral motion."

7957. *For Improvement in Spring Hinges.*—HARVEY D. SABIN and GEORGE DREW, of Canandaigua, N. Y. Dated Feb. 25. "What we claim as new, is the piece, to one side of which the spring is attached, and which has on the other side a projection with a hole therein, by means of which and a pin, the

spring can be engaged and disengaged when the door is shut."

7958. *For Machine for arranging and feeding Screw Blanks.*—THOMAS J. SLOAN, of New-York, N. Y. Dated Feb. 25. "What I claim as my invention, is the lifters which select and lift the blanks, &c., from the hopper, in combination with ways or conductors, or the equivalents thereof, into or on to which the blanks, &c., are transferred. And I also claim giving to the lifters or to the inclined ways, or their equivalents, a lateral motion, in combination with a stop or detector, for the purpose of arresting the operation of the lifters, until a farther supply is required."

7959. *For Improvement in Paper Moulds.*—WM. BREWER, of Malcolm Place. and JOHN SMITH, of Southville, England. Patented in England, Feb. 12, 1849. Dated March 4. "We wish it to be understood that we do not claim as of our invention, nor do we claim the exclusive use of the apparatus and machinery for stamping and filing, except when employed in and for the production of our improved plates or moulds. We hereby declare that we claim as our invention, the improved moulds for the manufacture of paper, as made in the manner herein specified; that is to say: by stamping or forming such moulds partly, or wholly, in and by dies, and afterwards removing the back of such moulds, by filing, or other process analogous thereto."

7960. *For Improvement in Power Governor.*—JUNIOUS JUDSON, of New-York, N. Y. Dated March 4. "What I claim as my invention, is communicating the acting of governors to the valves, or other parts of machinery governed thereby, in such manner as to cause, by accelerating or retarding the motion of said valves, large amounts of regulating power to be added to, or taken from the engine, by a given change of the speed, when the motion of the engine becomes too much retarded, whether such retardation arises from increase of work or resistance, or from diminution of the tension of the moving force and also small amounts of regulating power to be added to or taken from the engine, by a like change of speed, when the motion is too much accelerated, whether such acceleration arises from diminution of work, or resistance, or from increase in the tension, of the moving force. I also claim connecting the valve arm, or part to be regulated, to the regulator, by a cam or its equivalent, having progressive rates of action, when the same is employed for transmitting the action of governors to the parts of machinery to be governed, and for the purpose of causing the motions of valves, gates, weirs, or other analogous parts, to take place rapidly, for the regulation of low speeds, and slowly for the regulation of high speeds. I also claim making the eccentric curve of the vibrating cam to vary its position with respect to its centre of vibration, for the purpose of varying the rapidity and extent of opening of the valve, according to the pressure of steam."

7961. *For Improvement in Calculating Ma-*

chines.—JOHN W. NYSTROM, of Philadelphia, Pa. Dated March 4. "What I claim as my invention, is, First: The logarithmic curves of the outer scale in combination with the diagonals and graduated arms. Second: I claim the trigonometric curves of the inner scale, in combination with the graduated arms and logarithmic curves of the outer scale. Third: I claim the two graduated arms constructed in such manner, that they can be moved in connection or independently."

7962. *For Improved method of Bracing the water spaces of Boilers.*—BERNARD O'NEIL, of Reading, Pa. Dated March 4. "What I claim therein as new, is the method described, of bracing and securing the shells of boilers, or fire boxes, of locomotive and other engines, by means of ribands of sleeves, or stationary sleeves, so that when a bolt or bolts are to be removed to cure leaks, or to renew the sheets in the fire box, the sleeves will remain in place, serving as a guide to punch the new sheet by, and affording greater support to the shells, both in backing out the old, and riveting the new bolts."

7963. *For Improvement in Peppermint Droppers.*—HENRY H. SNOW, of New Haven, Conn. Dated March 4. "What I claim as my invention, is, First: The construction of a Peppermint Dropper, by combining a sugar kettle with a revolving cutter; and secondly: the combination of such dropper, either with a railway, the dropping sheet being stationary, or with a movable dropping sheet, the dropper itself being stationary, or with a railway and a movable dropping sheet combined."

7964. *For Variable Cut-Off, regulated by the Governor.*—HENRY WATERMAN, of New-York, N. Y. Dated March 4. "What I claim as my invention is, regulating a variable cut-off valve, by a motion derived from and corresponding to that of the governor, by means of a toe or vibrating lever attached to the rock-shaft, acted upon by revolving pins or cams, when either the cams are made to vary in position with respect to the toe, or the toe in length with respect to the cams."

7965. *Method of Adjusting the Stroke of Trip Hammers.*—LUTHER BRIGGS, JR. of Braintree, Mass. Dated March 11. "What I claim as my invention is, the construction of a trip hammer, in which the hammer is raised by cams, not acting directly upon the hammer or the helve, or a projection from the same, commonly called the lifting leg, but by the intervention of a movable joint, so constructed as to grasp or clutch the lifting leg at any required height, the position of the same being governed by the regulator, which may be constructed in the form of an inclined plane, or any equivalent contrivance, for raising and depressing the joint at the will of the operator."

7966. *For Improvement in Machines for Climbing Poles.*—HENRY D. CHAPMAN, of Baltimore, Md. Dated March 11. "What I claim as my invention is, the combination of

the grappling levers with the sandals and handles, for the purpose of climbing telegraph poles, masts, &c., and holding the climber at any desired height, so as to give him free use of his hands when at rest."

7967. *For Improvements in Cast-Iron Car-Wheels.*—PERRY G. GARDINER, of New-York, N. Y. Dated March 11. "The nature of my invention consists in constructing a railroad car-wheel of three principal pieces, or members of the same, which pieces are held together with screw bolts, that is to say, I make two cast-iron side-plates, each forming one-half of the eye, hub, arms, a horizontal or right angle flange to the plate, for the tire to rest upon, and a vertical flange at the outside periphery of the plate, to hold in place the tire, combined with a wrought-iron tire, which, when bolted together, constitutes the entire wheel. It is known that railroad car-wheels, having arms with open spaces between them, have a tendency, when running under ordinary speed, to agitate the adjacent air, disturbing the dust upon the railroad track, a circumstance of annoyance to passengers in the cars, and destructive to the journals and other wearing parts of the car gear; it is also known that the uneven sides of corrugated car or railroad wheels have a partial tendency in the same way; it is also known that plate wheels that have smooth and even sides have been made, which are not subject to the above objection, but are nevertheless liable to crush down by lateral strain, unless made very thick and heavy. My aim, therefore, in contriving the form of the wheel herein described has been, to make a wheel with such arrangement of metal as to give sufficient strength to resist lateral strain, with the least amount of weight of material possible; and yet make a full plate (even surface) wheel at the outside of the same, which I have accomplished, by forming in such plates, at the inside of the same, any number of radiating flanges, answerable to the ordinary arm of a wheel with open spaces; such flanges or arms extending from the hub part of the wheel to the flange at the inside periphery, upon which the tire is made to rest, and cast solid with the plate, projecting from the same so as to be level with the thickness of the hub, which is the one-half thickness of the wheel when put together, thus forming narrow or half-arms, the two half or semi-arms of each plate meeting opposite to each other at the inside, on the dividing line between them, when put together, and thus giving support to the external or outside plates (being a part of them) against lateral strain; and thus disposing of the metal of the wheel to the best advantage to attain sufficient strength, lightness of materials, and an even outside surface, having the least tendency possible to agitate the air and disturb the dust upon the track. It will be seen that the form of these side-plates is such that they may be cast without leaving in the casting, from the shrinkage in cooling, any injurious tension or strain of the metal, being a full and even disc of metal at the outside, filled in with low flanges, or half-arms

cast solid with such plates, and being mere ribs at the inside, to sustain and support the external plates, and are, in point of form, free from objections (as to the condition of the metal after it is cast), as it regards the effects of the shrinkage of the same in cooling. The combination of these well supported side-plates with a light-wrought iron tire, make up a wheel less in weight, in proportion to its strength, than ever has been heretofore made by the combination of the same mixed, wrought, and cast-iron materials; and in my belief I have attained to a new and useful improvement in the construction of railroad car-wheels. I do not make any claim to the combination, self-considered, of wrought-iron tire with a cast-iron body, or yet for full plate sides, or for internal arms in section, when cast solid with the side-plates of a railroad car-wheel, for such have all been known and used before; but what I do claim as new is, the precise manner in which I have constructed and put together the parts of my wheel, by which, thus formed, they are free of strain from shrinkage in cooling, and have semi-internal flanges to protect the wheel when in use against lateral strain, and are bolted together and combined with a wrought-iron tire."

7968. *For Improvement in Machinery for making Tires by continuous rolling.*—PERRY G. GARDINER, of New-York, N. Y. Dated March 11. "The nature of my invention consists in giving or furnishing a self-acting and adjustable means of arresting motion (either way) of the top shaft, and forming roller placed thereon. In making tires for railroad car or locomotive wheels, from a mass of iron formed in the bloom, or piled and welded from bars or slabs, and forged by any ordinary means into a circular flat piece, with a hole in the centre, the piece must have an appropriate quantity or weight of metal to make a given section and diameter of tire. It is important that the rollers cease to act at the precise time, to secure the required diameter of tire to fit the wheel, upon which it is thereafter to be set. In short, to roll such tire by the measure or judgment of the eye, is in point of economy impossible; but if the operator has the adjustable means, by set screws or otherwise, to trip a sway bar, throw out of gear cog wheel work, or slide a belt on a loose pulley, he may, by a few experimental trials, arrive at the exact point at which to arrest the advance and approach of the forming roller; and having ascertained this point, so set the parts fixedly, and by these means trip a lever, slide or move parts necessary to a stopping effect; so that all that remains of nicety to the operator to do, is to weigh accurately the mass of iron to be wrought or rolled into a tire; and making simple and easy that which would be difficult by the ordinary means of doing it be difficult of attainment." "What I claim as new, is: stopping the advancing movement of the movable towards the stationary roller, when the tire shall have attained its proper section, by means of self-acting mechanism. I also claim the combination of belts, pulleys, clutch-

es, screws, and screw wheels, with the sway bar and triggers, by which a self-acting, advancing, and retrograding motion is given to the movable roller, each motion changing to the other, when caused so to do by the hand of the operator, but self-arrested and stopped, by the set of the triggers."

7969. *For Improvement in connecting Trucks with Car Bodies.*—THOMAS P. HOW, of Buffalo, N. Y. Dated March 11. "What I claim as my invention, is, connecting the bodies of cars to the truck, by two bolts to each truck, working in the holes or mortices."

7970. *For Improved use of Slides in Bee-Hives.*—NATHANIEL POTTER, of Buffalo, N. Y. Dated March 11. "What I claim as new, is the manner of arranging the moth apartment with glass, paper, or other thin material, overlaying the vent holes in the top of the box, said glass or paper having placed upon it, old comb, or other suitable material, so as to be warmed by the bees in the boxes below, and ventilated as described, thus attracting the moths into said apartment, while they are, at night, entirely excluded from the bee-boxes by means of the ventilating buttons. I also claim the arrangement by which the upper box, or boxes, are held in their places, while the one below is removed, and another inserted in its place. Also the arrangement at the rear and bottom of each box, by which the tin slide is removed, thus allowing a convenient opportunity for clearing the bottom of the bee-boxes."

7971. *For Improved Window Curtain Fastening.*—HUGH GUYER, of Albany, N. Y. Dated March 11. "I claim the construction of rack pulleys for window shades, by fixing the pulley over which the cord of the shade roller runs, upon a stem, having a plate sliding on the front outer face of the rack box, attached to a thin plate, or fin, passing through a slot in said face, extending the length of the box, the said fin projecting upwards, and terminating in a point which acts as a pull against ratchet teeth made in the bottom of said box—or else the said fin projecting downwards and having a cross pin through it, acting against ratchet teeth in the upper and inner side of said box, the said stem and plate, in addition to the sliding motion along the box, having an oscillating motion on the upper or lower edge of the plate, by means of which the upward pressure of the cord on the pulley, holds the pull or pin against the ratchet teeth, or the downward pressure of the hand carries the pull or pin out of the line of the teeth, and permits the pulley to be moved upwards, when required."

7972. *For Improvements in Steam Drilling Machines.*—JOSEPH W. FOWLE, of Boston, Mass. Dated March 11. "In machines which have been recently devised for splitting and dressing stone, &c., by steam, the dressing or cutting tool has been so connected to the piston rod, as to be worked by the direct action of the steam. This feature I have incorporated in my improvements; and I have also combined with it an arrangement for supporting the engine, and the drilling tool which

it drives, in a frame which may swing, and be raised and lowered, so as to drill in any direction, and at any height; also a mechanical provision for turning the tool, and one for advancing it as the drilling progresses, and furthermore, an improved mode of preventing the direct action of the steam from throwing the piston, as the tool is drawn forward and back, through either head of the cylinder. What I claim as my invention, is the combination of a direct action steam drill, in which both engine and drill are mounted on a frame which slides in a swinging frame capable of being adjusted in any required position with the apparatus, which is connected with, and actuated by the cross head of the engine, for causing the sliding frame to move along the swinging frame toward the rock."

7973. *For Improvement in Air-Tight Franklin Stoves.*—RENSELAER D. GRANGER, of Albany, N. Y. Dated March 11. "What I claim as my invention is, making the fire-box, with closed plate in front and behind, with a grate surface at bottom, occupying about one-third of the space between the front and back stove plates, to constitute hot-air chambers front and back, when such fire-box is combined with a sliding damper at bottom; and I also claim, in combination with a fire-chamber, constructed and governed at bottom with a sliding damper, the open front, with vertically sliding doors."

7974. *For Improvement in Securing Dquerreotypes in Monumental Stones.*—SOLON JENKINS, JR., of West Cambridge, Mass. Dated March 11. "What I claim as my invention is, the mode of securing the portrait plate against injury, from moisture or otherwise, by means of two glass plates, the plaster and back plate."

7975. *For Improvement in Cooking Stoves.*—JAMES GREEN and RUFUS J. KING, of Dayton, O. Dated March 11. "What we claim as new is, a combination of the diving flue, as described, with the said flues occupying the whole breadth of the stove, with the exception of the space occupied by the fire-doors and the central reverting flue in the back. We also claim the gravitating damper, operated as described, that is to say, by the rod with its curved eye, and the pendent lever with its bend and catch, the said damper being located upon the division plate, between the back diving flues and the central back reverting flue."

7976. *For Improvement in Piano-Forte Action.*—JOHN RUCK, of New-York, N. Y. Dated March 11. "What I claim as new in my invention is, 1st. Hanging the hammer shank on a hinge or joint, at a distance from its end, and effecting its communication with the fly lever or jack, by means of a lever which is hung on a fulcrum, at a distance from either end, and is connected at one end by a hinged or jointed link, with the end of the hammer shank, in such a manner that when the fly lever is raised by the key, the end of the hammer shank is drawn down, and the hammer thrown up to the string, or by any other means substantially the same. 2d. The universal repeating string, attached to

the lever or butt, upon which is formed the projection, or its equivalent, through which the fly lever communicates with the hammer, for the purpose of raising it, and working upon the end of the fly lever, in the manner substantially as and for the purpose herein set forth. This I claim without reference to the precise form of the projection, or of the spring herein shown, as various modifications may be made for producing the same effect. 3d. Attaching the check wire to a hanging or hinged butt, operated upon by the key, in the manner substantially as described, so as to produce the same effect as if attached to the key, for the purpose of allowing the key to be easily taken out. 4th. Securing or placing the regulating screw for controlling or regulating the escapement of the fly lever in an arm, or its equivalent, upon the lever upon which the fly lever acts, by which the action of the said screw upon the fly lever is more gradual and easy, and the jarring or concussion produced, when the screw is stationary, is avoided."

7977. *For Improvement in Machines for Turning, Boring, &c.*—MARTIN and THOMAS R. WAY, of Paintersville, Ohio. Dated March 11. "What we claim in the foregoing as our invention is, the tool and block holder herein described, consisting of two upright frames, capable of movement towards each other, and of being clamped at a greater or less distance apart, as may be required, to adapt them to holding blocks of different sizes, and tools of different lengths or forms, each frame being provided with upright parallel guides, carrying adjustable jaws, for holding, boring, or turning tools, at different heights and angles, and to aid in holding blocks of irregular forms, these frames being mounted upon a carriage capable of being turned or moved, right or left, so as to hold the tool, or present the substance to be bored in the required position."

7978. *For Improvement in Copying Presses.*—A. A. WILDER, of Detroit, Mich. Dated March 11. "What I claim as my invention is, the use of a lever handle, having its fulcrum on the pressing plate, attached to the opposite plate by links, as shown, working in the manner described, in combination with the adjusting arrangements, for the purposes expressed, and operating together, as shown, or in any substantially similar manner."

7979. *For Improvement in the Teeth of Saws.*—GEORGE F. WOOLSTON, of Orangeburg, S.C. Dated March 11. "I claim as my invention the insertion of teeth in circular saw blades, of the form and for the purpose above set forth."

7980. *For Improvement in Dressing Mill-Stones.*—EDMUND P. GAINES, of Nacogdoches, Texas. Dated March 4. "What I claim as my invention is, a new and improved mode of dressing mill-stones."

7981. *For Improvement in Trunk Handles.*—ELIJAH A. ANDREWS, of New Britain, Conn. Dated March 18. "What I claim as my invention is, casting the article in two parts, in such a form that they may be put together without any alteration of the parts, and so

that they cannot get out of place when the handle is attached to a trunk or other article, when the whole is constructed."

7982. *For Improvement in Delicering Part-Colored Warps in Weaving.*—E. B. BIGELOW, of Clinton, Mass. Dated March 18. "What I claim as my invention is the method of producing figures that will match, on tapestry, carpets, or other fabrics, woven with printed warps, by the employment of a clamp or clamps, to be clamped on to the warps, in combination with belts, or their equivalents, having a positive delivery motion, and to which the said clamp or clamps can be attached at given distances."

7983. *For Improvement in Jacquard Looms for Weaving Cut-Pile Fabrics.*—ERASTUS B. BIGELOW, of Clinton, Mass. Dated March 18. "What I claim as my invention is, combining with the power-loom for weaving cut-pile fabrics double, a jacquard machine for producing the figures on such fabrics. I also claim, in the weaving of cut-pile fabrics double, with the figures produced by the jacquard, dividing the figuring warps, so that one-half, or nearly so, of the figuring warps shall be in connection with each of the cloths or fabrics. I also claim, for the weaving of cut-pile fabrics double, the double and reversed arrangement of the jacquard. I also claim, in the weaving of fabrics of the kind herein described, passing the double fabric between two vibrating bars, having curved faces to determine the length of pile between the two cloths, in combination with the two rollers, or their equivalents, over and under which the fabrics pass, after they have been separated; and this I also claim, in combination with a vibrating knife or knives, for cutting the pile, to separate the two fabrics."

7984. *For Improvement in Fastenings of Scythes to the Snath.*—E. S. CLAPP, of Montague, Mass. Dated March 18. "What I claim as new in my invention, is setting the edge of the blade up or down, or more or less obliquely, by means of the adjusting screw, in combination with the edge of the aperture, which form the bearings of the two sides of the shank of the blade."

7986. *For Improvements in the method of casting the back upon the teeth of Currycombs.*—JAMES M. GARDNER, of Troy, N. Y. Dated March 18. "What I claim as my invention, is the employment of a bar, in combination with the cope of a two part flask, for casting the back on to the plates of currycombs, the said bar being notched to receive and hold the said plates during the process."

7987. *For Adjustable Cut-off.*—SAMUEL H. GELMAN, of Cincinnati, Ohio. Dated March 18. "What I claim therein as my invention, are, 1st. The tappet vibrated by the impact of projections upon the slide valve rod, and lifting thereby a poppet valve which admits steam to the slide valve chamber, during periods varying with the height to which the tappet is placed, by the elevation or depression of the sliding rod or other object to which it is pivoted, said rod being raised or

depressed by a motion derived from the governor, or communicated to it in such other manner as may be deemed expedient. 2d. I claim the mechanism substantially as described, for prolongation of the admission of steam beyond the period at which it would be cut off, by the tappet, to wit: the sliding plate and the intervening bar, the former with a pair of receding inclined planes or edges, and the latter with an equal and parallel pair of salient planes, which, by sliding upon the former, hold up the poppet valve after the tappet has ceased to act, for a period likewise depending upon the movement of the rod, which latter may be actuated as set forth in the former claim."

7988. *For Improvement in Cylinders for Figuring Looms.*—ELIAH M. HASTINGS and JOHN SHEPHERDSON, of Jamestown, N. Y. Dated March 18. "What we claim as new, is the mode of connecting the movable cans and slide pieces with the drum, substantially as set forth, and for the purposes herein stated."

7989. *For Improvement in Scythe Fastenings.*—EBENEZER G. SAMSON, of Shelburne, Mass. Dated March 18. "What I claim as my invention, is the method of securing or fastening the scythe to the snath by means of the clamp jaws acting on the beveled or curved edges of the wedge-formed shank, in combination with the method of holding down the end of the shank by means of the till thereon, which works on to the toothed plate of the recess, as described, whereby the scythe is held more firmly to the snath to resist all strain, than by any other method heretofore practised. And I also claim the method, substantially as described, of spotting the scythe, that is, regulating the line that it shall have, relatively to the curves of the snath, by means of the movable or adjusting plate, the edge of which forms the bed for the shank of the scythe when drawn down by the clamps, as described."

7990. *For Improvements in Jacquard Machines.*—JOHN SCOTT and JOHN TANNAHELL, of Philadelphia, Pa. Dated March 18. "What we claim as new in our invention, is, 1st. The manner of operating the cylinder by means of the double lockers, in combination with the springs, whereby its complete operation is effected by the upward motion of the trap board. 2d. The application of weights to the tail cords above the harness, for the purpose of more effectually keeping them tight or straight, and thereby insuring the more correct operation of the trap boards and needles upon them."

7991. *For Improvement in the construction of Bee Hives.*—ALBERT J. SURLS, of Florence, Ga. Dated March 18. "What I claim as my invention, is having the comb placed within the trap, fortified or protected from the moth or other insects, by the diaphragm, substantially in the manner herein fully explained."

7992. *For Improvement in Removable Handles to Sad-Irons.*—T. R. TRIMBY, of Meridian,

N. Y. Dated March 18. "What I claim as my invention, is the method of constructing sad, tailors' and other hand smoothing irons with handles, which can be readily and securely attached to the iron, and easily detached therefrom, substantially as herein specified."

7993. *For Improvement in the construction of Metallic Buildings.*—SIMON WILLARD, of Cincinnati, Ohio. Dated March 18. "What I claim as new and of my own invention, is carrying up the vertical shaped flange binders between the flanges of the roof plates, to which they are attached, thus supporting the roof and binding it firmly to the building. I also claim such binders attached in such a manner, in connection with the tie plates or rods attached to the same spot between the flanges, and by the same bolts; and this I claim whether the suspension bars be employed or not."

REISSUES.

190. *For Improved arrangement of Steam Boiler and Furnace thereof.*—HORACE BOARDMAN, of Plattsburgh, N. Y. Patented Aug. 14, 1849. Reissued Feb. 25, 1851. "What I claim as my improvement in steam boilers, is the combination of a fire chamber and a water casing, the upper horizontal sections of both of which, are greater than their lower, with a descending flue; the fire chamber and water casing being so arranged with respect to each other, that the larger sections of the one adjoin the larger sections of the other. I likewise claim the injection of a jet, or jets of air, at the flues or passages which connect the combustion chamber with the descending flue, for the purpose of igniting the gases and retarding their progressive motion towards the bottom of the gas chamber."

191. *For Improvement in Carriages.*—JOHN JONES, of Clyde, N. Y. Patented Jan. 14, 1851. Reissued March 4, 1851. "What I claim as my invention, is the arrangement of two bars, or reachers, placed in connection with the straight reach, and in combination with the spring rod and cross bar."

192. *For Improvement in Cutting Stone.*—CHARLES WILSON, of Springfield, Mass. Patented March 13, 1847. Reissued March 4, 1851. "What I claim as my invention, is, the method of dressing, facing, or reducing stone and other like materials, by means of a rolling edge, or edges, acting against the face or surface of the material to be worked."

193. *For Improvement in Firearms.*—WILLIAM W. HUBBELL, of Philadelphia, Pa. Patented July 1, 1844. Reissued March 11, 1851. "What I claim as my invention, is, First: The combination of the two independently adjustable braces, extending one on each side of the breech chamber containing the charge that is being fired, to regulate and accurately determine the joint between the breech and barrel. Secondly: I claim the breech opening and closing on an axis which is parallel to the main barrel, and secured and regulated by the parts."

194. *Improvement in Evaporators and Condensers.*—EDWARD LYNCH, of Brooklyn, N. Y. Patented July 18, 1848. Reissued March 11, 1851. "What I claim as my invention, is, the partition within the tank, for the purpose of dividing the water of the evaporator from that of the condenser."

DESIGNS.

351. *For Designs for Cooking Stoves.*—SAMUEL H. SAILOR, of Philadelphia, Pa., Assignor to Warwick, Leibrandt & Co. Dated Feb. 25. "What I claim as my invention, is, the application of the above design to Cooking Stoves."

352. *For Design for Furnace Registers.*—GARDNER CHILSON, of Boston, Mass. Dated March 4. "What I claim as my invention, is, the new design for a register in the form of a circle, having within and near to its outer ring, two concentric rings, the space between each of said rings being ornamented with curved lattice work, forming hyperbola-shaped openings, and a ring in its centre inclosing an eight-leaved star, with a small circle in its centre, and curved and notched branches radiating from the said ring to the smaller of the outer rings, forming irregular and heart-shaped openings."

353. *For Design for Furnace Registers.*—GARDNER CHILSON, of Boston, Mass. Dated March 4. "What I claim as my invention or production, is, the new design for a register for furnaces, &c., of rectangular form, having within it a smaller rectangle connected to the edge of the register, by curved bars of the shape shown in the drawing, said inner rectangle having a square in each corner, and small rectangles within its sides, said squares being ornamented with curved bars, forming the lattice work, &c., and said smaller rectangles being ornamented with semi-circular and diamond-shaped lattice work, and a rectangle in the centre of the register, ornamented with irregular curved branches or bars proceeding from its sides to a ring, inclosing a four notched-leaved star, the whole forming a lattice or open work for the heat to pass through."

354. *For Design for Furnace Registers.*—GARDNER CHILSON, of Boston, Mass. Dated March 4. "What I claim as my production, is the new design for a register of rectangular form, having within its sides two smaller rectangles, one within the other, the space between the outer bars of the register and the larger rectangle, being ornamented with curved lattice work, and the triangular openings, and the space between the two inner rectangles being ornamented with irregular heart and diamond-shaped openings, while the centre of the register is occupied by a five oval-leaved star in a ring, with curved and notched branches or bars running from said ring to the inner rectangle."

355. *For Design for Registers for Furnaces.*—GARDNER CHILSON, of Boston, Mass. Dated March 4. "What I claim as my invention or production, is the new design for a regis-

ter of rectangular form, having within its sides a smaller rectangle, the space between the two being ornamented with the circular and diamond-shaped lattice work shown in the drawing, the inner rectangle being ornamented with irregular curved bars or branches running from its sides to a ring in its centre, which inclose a five-pointed star with curved sides; the whole forming a lattice work for the passage of the heat."

356. *For Design for Stoves.*—SAMUEL W. GIBBS, of Albany, N. Y., Assignor to Jagger, Treadwell & Perry of same place. Dated March 4. "What I claim, is, the combination and arrangement of ornamental figures and forms represented in the annexed drawings, as making an ornamental design for a six plate stove."

357. *For Design for Stoves.*—SAMUEL W. GIBBS, of Albany, N. Y., Assignor to Jagger, Treadwell & Perry of same place. Dated March 4. "What I claim as my production, is, the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for the side of a Cooking Stove, and the back and front plates of the elevated oven."

358. *For Design for Stoves.*—JOHN S. PERRY, of Albany, N. Y. Dated March 4. "What I claim as my invention, is, the combination and arrangement of ornamental forms and figures represented in the accompanying drawings, and forming a Design for an ornamental Cooking Stove."

359. *For Design for Stoves.*—SAMUEL W. GIBBS, of Albany, N. Y., Assignor to Jagger, Treadwell & Perry of same place. Dated March 4. "What I claim as my invention, is, the combination and arrangement of ornamental figures, shown in the accompanying drawings, forming a new ornamental design for an air-tight Box Stove."

List of English Patents issued from Dec. 26, 1850, to Jan. 23, 1851.

George Edward Dering, of Lockleys, Herts, Esq., for improvements in the means of and apparatus for communicating intelligence by electricity. December 27; six months.

John Mathison Fraser, of Mark-lane, London, merchant, for improvements in the manufacture of sugar. (Being a communication.) Dec. 27; six months.

John Ransom St. John, of New-York, America, engineer, for improvements in the construction of compasses and apparatus for ascertaining and registering the velocity of ships or vessels through the water. December 27; six months.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman, for improvements in the construction of metal shutters. (Being a communication.) December 27; six months.

Celeste Menotti, of No. 6, Rue de la Paix, Paris, gent., for certain chemical compositions for rendering cotton linen, woollen silk, and other fabrics, impervious to water. December 27; six months.

William Henry Jones, M. A., of Queen's College, Oxford, and of Chorley, Sussex, clerk, for improvements in apparatus to be used when burning candles. December 28; six months.

Thomas Symes Prideaux, of Southampton, gent., for improvements in generating and condensing

steam, and in fire-places and furnaces. December 23; six months.

James Slater and John Nuttall Slater, of Duns-car, of Lancaster, bleachers, for certain improvements in machinery or apparatus for the purpose of stretching and opening textile or woven fabrics. December 28; six months.

John Tatham and David Cheetham, of Rochdale, Lancaster, machine makers, for certain improvements in steam engines, in apparatus for generating and indicating the pressure of steam, and for filtering water to be applied to boilers; also improvements applicable to steam vessels or ships. January 2; six months.

Josiuua Horton, of Etna Works, Smethwick, Stafford, steam-engine, boiler, and gasholder manufacturer, trading under the firm or style of "Joshua and William Horton," for improvements in the construction of gasholders. January 2; six months.

John Corry, of Belfast, Ireland, damask manufacturer, for improvements in machinery or apparatus for weaving figured fabrics, which machinery or apparatus is also applicable to other purposes for which Jacquard apparatus is or may be employed. January 2; six months.

Benjamin Cook, of Birmingham, manufacturer, for a certain improvement, or certain improvements, in the manufacture of metallic tubes. January 3; six months.

John Percy, of Birmingham, doctor of medicine, and Henry Wiggins, of the same place, manufacturer, for a new metallic alloy, or new metallic alloys. January 3; six months.

Thomas Lawes, of 32 City-road, Middlesex, for improvements in generating and applying steam for certain purposes. January 4; six months.

John Harcourt Brown, of Fir-cottage, Putney, Surrey, gentleman, for certain improvements in the manufacture of wafers. January 7; six months.

Henry Grissell, of the Regent's Canal Iron Works, Middlesex, engineer, and Theophilus Redwood, of Montague-street, in the same county, professor of chemistry, for improvements in coating metals with other metals. January 11; six months.

John Alexander Archer, of the Broadway, Westminster, tobacco manufacturer, for improvements in the manufacture of tobacco. January 11; six months.

Samuel Hall, late of Basford, near Nottingham, civil engineer, for improvements in the manufacture of starch and gums. January 11; six months.

William Melville, of Roe Bank Works, Lochwrinnoch, Renfrew, North Britain, calico printer, for certain improvements in manufacturing and printing carpets and other fabrics. January 11; six months.

Thomas Allen, of Glasgow, Lanark, North Britain, ironfounder, for certain improvements in paving or covering roads, streets, and other surfaces of a similar nature. January 11; six months.

George Anstey, of Brighton, Sussex, gentleman, for certain improvements in consuming smoke, and in regulating the draught in chimneys. January 11; six months.

William Robinson, of Holsham, in Holderness, in the East Riding of the county of York, machinist and agricultural implement maker, for improved machinery for separating corn from straw. January 11; six months.

John Clarkson Milnes and Samuel Pickstone, of Radcliffe Bridge, Lancaster, manufacturer, for certain improvements in machinery or apparatus used in spinning, doubling, and weaving cotton, flax, and other fibrous substances. Jan. 11; six months.

Alexander Speid Livingstone, of Swansea, Glamorgan, engineer, for improvements in the manufacture of fuel. January 11; six months.

Charles Barlow, of Chancery-lane, London, Esq., for improvements in propelling. (Being a communication.) January 11; six months.

Charles Barlow, of Chancery-lane, London, Esq., for improvements in machinery for the manufacture of railway chairs. January 14; six months.

Gustav Adolph Buchholz, of Agar-street, Strand,

Middlesex, civil engineer, for improvements in printing, and in the manufacture of printing apparatus, and also in folding and cutting apparatus. January 16; six months.

Robert Cogan, Leicester-square, Middlesex, glass merchant, for improvements in the application of plain or ornamental glass alone, or in combination with other suitable materials, to new and useful purposes of construction or manufacture. January 16; six months.

Charles Cowper, of Southampton-buildings, Chancery-lane, Middlesex, for improvements in the construction of apparatus for manufacturing, and apparatus for retaining and drawing off soda-water and other aerated liquors. January 16; six months.

Frederick Watson, of Moss-lane, Halme, Manchester, gentleman, for improvements in sails, rigging, and ships' fittings, and machinery and apparatus employed therein. January 16; six months.

Charles William Lancaster, of New Bond-street, Middlesex, gun-maker, for improvements in the manufacture of firearms and cannon, and of projectiles. January 16; six months.

Jean Marie Taurines, of Paris, engineer, for certain improvements in the machinery and apparatus for measuring and regulating the working of engines. January 16; six months.

Richard Bycroft, of Paradise Wolsoken, Norfolk, gentleman, for improvements in apparatus to be used by persons to secure warmth and dryness when travelling. January 18; six months.

George Normard, of Shoreditch, Middlesex, cabinet-maker, for an improved cooking and boiling apparatus. January 18; six months.

George Frederick Munty, junior, for improvements in furnaces applicable to the melting of metals for making brass, yellow metal, and other compound metals. January 18; six months.

John Lienard, junior, of Wharf-road, City-road, Middlesex, merchant, for improvements in purifying or filtering oils and other liquids. January 18; six months.

William Rees, of Pembrey, Carmarthenshire, coal agent, for certain improvements in the preparation of fuel. January 18; six months.

Edmund Pace, of the firm of Taylor and Pace, of Queen-street, London, iron-bedstead makers, for certain improvements in ironbeds, couches, chairs, and other like articles of furniture. January 21; six months.

George Elliot, of Saint Helens, Lancaster, chemist, for improvements in the manufacture of alkali. January 21; six months.

William Burgess, of Newgate-street, London, gutta percha dealer, for improvements in machinery for cutting turnips and other substances. January 21; six months.

Robert William Sievier, of Upper Holloway, Middlesex, gentleman, for improvements in weaving and printing or staining textile goods or fabrics. January 21; six months.

Charles Roper Mead, of Charlotte Cottages, Old Kent-road, Surrey, mechanical engineer, for improvements in apparatus for measuring gas, water, and other fluids. January 21; six months.

John Ransom St. John, of New York, in the United States of America, engineer, for improvements in the process of and apparatus for manufacturing soap. January 21; six months.

Samuel Clift, of Bradford, near Manchester, manufacturing chemist, for improvements in the manufacture of potash, soda, and glass. January 21; six months.

Auguste Loradoux, of Bedford-street, Strand, for certain improvements in machinery or apparatus for raising water and other fluids. (Being a communication.) January 21; six months.

Alexander Samuelson, of Banbury, agricultural implement manufacturer, for improvements in apparatus for cutting turnips, carrots, mangel-wurzel, and other vegetables. January 23; six months.

Joseph Bunnett, of Deptford, Kent, engineer, for certain improvements in public carriages for the conveyance of passengers. January 23; six months.

CORRESPONDENCE.

PRESUMING that our correspondent asks in good faith, we append the following:—

Meerschäum pipes are made of a kind of fuller's earth, called *Keffkil*, (literally foam-earth,) formerly dug in pits in the Crimea, but now in Anatolia. The *Keffkil* is pressed into moulds upon the spot, dried in the sun, and baked in an oven; the pipes are then boiled in milk, and polished with a soft leather, after which they are carried to Constantinople. They are then brought up by German merchants, who transport them to Pest in Hungary, where, as yet large and rude, they are soaked in water for twenty-four hours, and then turned in a lathe; the sound ones are for the most part sent to Vienna, where they are finished and often expensively mounted in silver.

They afterwards find their way to all the German fairs, and obtain various prices, from two to forty pounds sterling, those being the most esteemed which, from having been long smoked, become stained of a deep yellow, or tortoiseshell-color, from the oil of the tobacco. The *Keffkil* is used in the public baths at Constantinople for cleansing the hair of the women. See Dr. Clarke's *Travels in Russia, Tartary, and Turkey*, &c., vol. ii. 4th ed. p. 282.

GUTTA PERCHA LIFE BOATS.—We have long thought that the great tenacity or toughness of gutta percha, as well as its extreme lightness, rendered it invaluable for the construction of life-boats, and have regretted that it has not yet come into more general use. We call attention to the peculiar properties of gutta percha, and its admirable adaptability for life-boats, by citing, in confirmation of our belief, the unbiassed testimony of Mr. Snow, who accompanied the Prince Albert in search of Sir John Franklin. In the latter part of August he was ordered by the Captain of the Prince Albert to land in the gutta percha boat on Leopold Island in search for traces of the previous visitors. The landing was rendered extremely dangerous and difficult, in consequence of the quantity of ice which blocked up the entrance to the harbor. "Accordingly," says Mr. Snow, "we gave the gutta percha a fair trial, perhaps a better trial than it had ever experienced before, and forcing her through the outer edge of the ice, soon got her well into it. She behaved admirably; every voice was in praise of her: the gutta percha resisted the ice in a manner truly surprising, and glided past it unhurt; whereas, if we had had our mahogany, or any other kind of boat, it would have been in great danger, and, in all probability, on our returning through the ice afterwards, would have been crushed like an egg-shell. In a short time, with some degree of difficulty, we got through, and effected a landing on the extreme end of Whaler Point."

GRAEVES' PORTABLE METRONOME.—This is a cheap substitute for Maelzel's well-known metronome, or time measurer for musical performances. It consists simply of a little flat weight suspended from a taper, graduated on one side from 60 to 160—the number of vibrations per minute—and marked on the other side with all the Italian musical rates, from *Adagio* to *Presto*. The upper end of the tape is attached to any fixed point, such as the corner of a music-stand, by a small spring-holder, rendering it easily adjustable at a moment's warning. In shortening the length of tape forming the pendulum, it is rolled up with the weight or "bob," which is adjustable at any height, by a sliding detent on the latter. The tape is 40 inches long, and the whole, when wound up, is small enough to be carried in the waistcoat pocket. By rolling up or letting down the pendulum weight, any required number of vibrations may be obtained, in accordance with the index graduations; and whilst its action is as good as Maelzel's, it is immeasurably simpler and cheaper. Its vibrations are kept up by an occasional touch of the finger—a single impulse being sufficient to keep up its movement long enough for the execution of several pages.

ANOTHER new motive power has (it is said) been discovered by Professor Salomon, of Harrisburg, Ky. It is no other than the application of carbonic acid gas, as a substitute for steam in propelling machinery. Prof. S. claims to be able to control it with perfect safety, and that it will afford a power equal to steam in one-fiftieth of the space, and one hundredth part of the expense, dispensing with both furnaces and boilers. Experiments have recently been made in Cincinnati, which are said to be entirely satisfactory. A slight change in the Professor's name is all that is wanting to insure our entire confidence in the scheme.

STEREO-CHROMIE is a new mode of fresco painting, and the discoverer is Professor Fuchs, of Munich. Its advantages over ordinary fresco and encaustic painting are, its greater durability, and the power which it affords the painter of retouching and glazing his picture. The color is mixed with the water; and the whole is permanently fixed by occasional sprinkling of water, in which is mixed a certain proportion of fluoric acid (*Fluss-spath saure*). Stereochromie is, in fact, a preserver of the wall on which it is painted. By the chemical action of the solution sprinkled over the picture whilst in progress, the whole ground on which it is painted, and the picture itself, become one hard flinty mass, and the very colors are converted into the hardest stone. So hard, indeed, is it, that neither fire nor damp has the slightest effect on it. The most striking experiments have been made to test it during the last twelve years; and in order to show the resistant power of the painting, M. Kaulbach laid a specimen on the ground, poured spirits of wine profusely over it, and set it on fire, but after the combustion not a stain or scar remained on the picture.

The colors are not combined, as in *afresco*, with lime, but with a solution of silic; and all the advantages of fresco painting are obtained without any of its disadvantages. This species of painting resists every influence of climate, and may be confidently used as an external coating for buildings in any part of the world. To the artist himself, it offers the most important recommendations. He is not confined to time in executing it. He can leave off when he pleases, and for any length of time, which he cannot do in fresco work by any means. The highest advantage of all, however, is, that the same part may be painted over and over, as often as you please—which is not possible in fresco; and, consequently, in this new mode, the most perfect harmony may be preserved throughout the largest possible painting.

We learn that a clergyman in this State, by the name of Hill, has discovered a method of procuring photographic images with all the vividness of the camera obscura. The process is, as yet, a secret, but rests upon the discovery of a new chemical compound. We hope it may prove true, but we are very mistrustful of such wonderful results, when they select the early part of this month for their advent.

C. D., Newark, New Jersey.—We regret that his article is unavoidably postponed until the next number of the Magazine. The preparation of engravings is always attended with more or less uncertainty in respect of time, and our engravers form no exception to the rule.

S.—The article on atmospheric pile-driving is also delayed from the same cause.

INSTITUTE OF ENGINEERS.—The notice of officers elected by the Institute of Engineers of the City of New-York, for the coming year, is received, but too late for insertion in its proper place in the present number of the Magazine. Recognizing, in the establishment of this institution, a common object, and aiming with its members at the improvement of the young mechanic, we shall heartily co-operate with any measure calculated to establish on a proper footing so important an institution.

APPLETONS'

Mechanics' Magazine and Engineers' Journal.

VOL. I.]

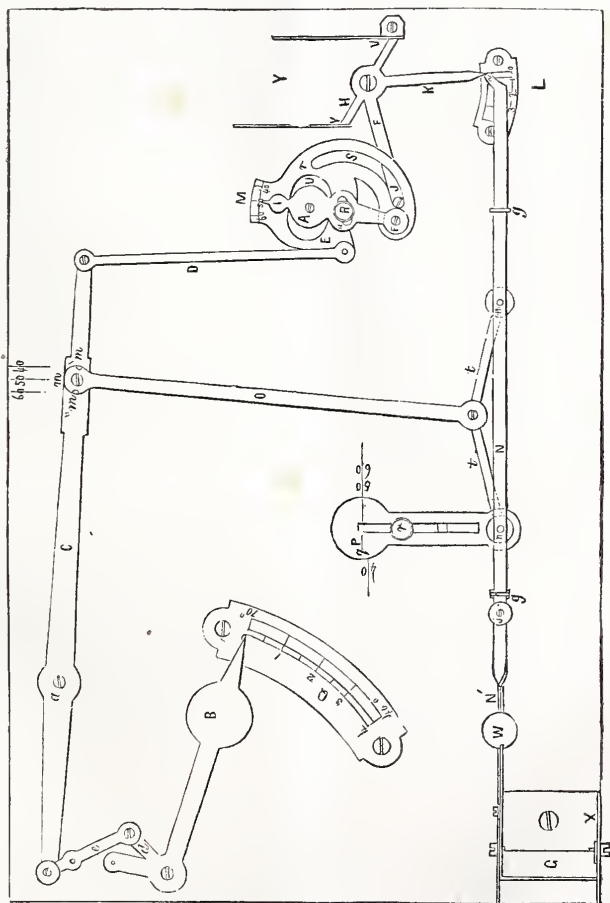
THURSDAY, MAY 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 5.

JUDSON'S IMPROVEMENTS IN GOVERNORS.

Fig. 1.



JUDSON'S IMPROVEMENTS IN GOVERNORS.

Patent dated March 4th, 1851. JUNIUS JUDSON, of the City of New-York.

My principle of governing motive power applies to steam, water, and other agents. I suppose that there is a certain range of speed which may be allowed, without detriment to the mechanical operations performed, but that the limits are restricted, and that a pendulum governor rises and falls only through a limited vertical arc, when regulating the supply of motive power to the machinery, from one extreme to the other of its appropriate speed, and that any other kind of governor is similarly limited in the range of speed governed. I also suppose that, when the speed falls to its lowest admissible rate, the valve, gate, weir, &c., is entirely open, and when the speed has attained the highest rate, which safety allows, it will cause the governor entirely to close the apertures through which the motive power passes. From its highest to its lowest rate, the speed may vary, as is well known, either on account of increased or diminished resistance, that is, the greater or less quantity of work to be done in a given time, or in consequence of diminished or increased force in the motive power, such as the elasticity of steam or the supply of water.

When, from either of these causes, speed has fallen below the medium, and approaches the minimum rate, the prompt restoration of the medium rate requires a rapid supply of power; but when, from the reverse circumstances, that is, either a diminution in the amount of work, or an increase in the tension or force of the moving power, the speed has risen to or near its maximum of safe action, a small change only in the rate of supply is adequate to bring back the speed rapidly to the proper medium for the new circumstances. It is not, in this view, supposed that the speed will be absolutely the same with heavy loads or low pressures of steam, &c., as it is with light loads or high pressures, but it is supposed that the rate of admitting the power will, in either case, be such as to meet with promptitude and to counteract any tendency to alternate slow and rapid actions of the machinery when no variation of the work takes place.

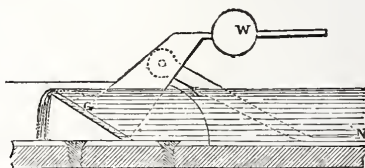
To accomplish the proper regulation, I cause the valve to move rapidly when re-

gulating slow speeds, and slowly when regulating high speeds—that is, by a given number of degrees of vertical elevation of the balls or arms of the governor, when near the lowest point of the vertical movement, they cause the valve or gate to open or close a proportionably large part of its whole opening; and, on the other hand, by the same number of degrees of elevation or depression near the upper part of their range, the governor is made to close or open a comparatively small part of the entire extent of valve opening.

The following description of the drawings, will make known the manner in which I effect the objects above specified:

In figures 1 and 2, similar parts are referred to by the same letters. Both figures represent the same apparatus, which I have devised, to illustrate the action of my machine, but in different positions of all the principal parts. In figure 1, the valve *H*, which regulates the passage of steam through the pipe *x*, is seen to be closed, its two extremities being in contact with the valve seat *v v*, and the water gate, *G*, is raised up so as to prevent the passage of water through the weir channel *x*. This position of the gate is more fully illustrated in the vertical section, figure 3, where *G* is the gate, *w* a

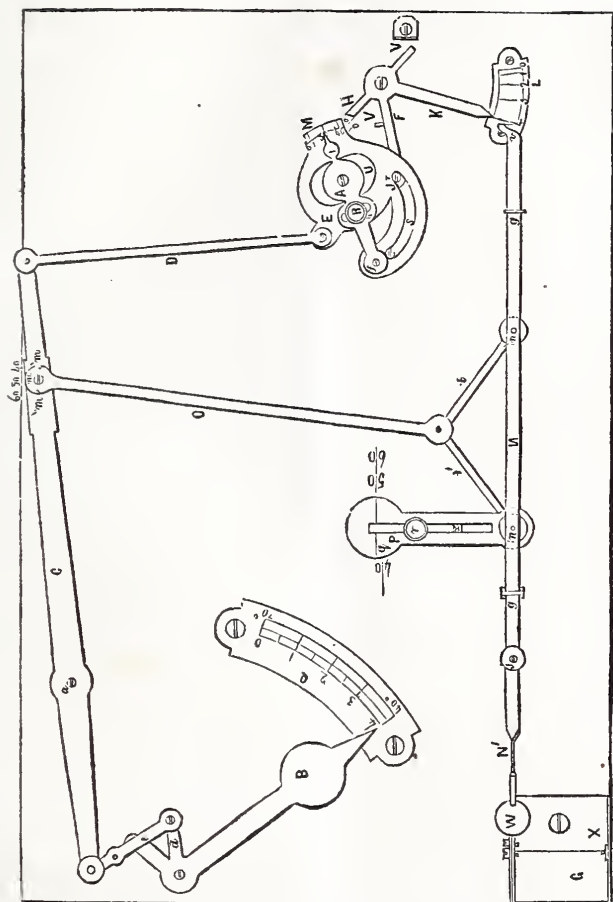
Fig. 3.



counter weight, and *N* a connecting rod for drawing up and letting down the gate. In figure 2 the valve *H*, and the gate *G*, are both seen to be wide open.

B represents one of the balls of a pendulum governor, of which the vertical spindle is not shown. *Q* is a scale marking the different elevations to which the balls rise—the lower extremity being marked 40° and the upper 70° . The connecting pieces, *d* and *e*, connect the ball *B* with the lever *c*, in such a manner that when *B* is at 70° , the arm of the lever, with

Fig. 2.



which the connecting rods *o* and *d* are joined, is depressed to its lowest point, as seen in figure 1; and when *B* stands at 40° on the arc *q*, as in figure 2, other connecting rods are drawn up to the highest elevation.

E is a vibrating cam, moved by the action of the connecting rod *d*; when *d* is depressed, the cam comes into such a position that the pin or wrist *j*, comes to the lower extremity of the eccentric slot *s*, as in figure 1, thereby closing the valve *H*; but when the ball *B* falls to 40° , as in figure 2, the vibration of the cam drawn into position there represented, causes the pin *j* to be found at the upper extremity

of the slot *s*, and then the valve *H* is opened to its greatest extent. Attached to the valve stem is an index rod *k*, which, in figure 1, is seen to point to *o*, on the scale *L*, and, in this position also, there is no opening of the valve *H*. In figure 2, the index *k* points to 4, the highest number on the scale *L*. The divisions on this scale are unequal—smallest from 0 to 1, and largest from 3 to 4.

The scale *q*, over which the pointer on the ball *B* moves, is also seen to be divided into parts and numbered from 0 to 4. But the divisions are, in this case, equal. In the position of the apparatus, seen in figure 1, the pointer of *B* is at the

zero on *Q*, and the index *K* at the zero on *L*, by the motion of *B* from 0 to 1, 1 to 2, 2 to 3, &c., the index *K* will be made to pass successively over unequal and increasing spaces on the arc *L*, showing that the valve *H* also opens unequally fast in the different parts of the range of its motion.

By the same descending motion of the ball *B*, from 0 to 4, on its scale *Q*, the elevation of the connecting rod *O*, from the position in figure 1 to that in figure 2, raises the two toggle joint arms, or progressive levers *t* and *t'*, from a nearly horizontal to a highly inclined position; and as the arm *t'*, of the toggle, has a fixed point or axis *N*, and the arm *t* a movable axis *n* on the bar *X*, the change of position of the arms *t* and *t'*, from the position in figure 1 to that in figure 2, causes the end *v* of the bar *X* to recede from its position at the 0 point over the scale *L* to that seen in figure 2; and by this motion of the bar, the gate *G* is brought down from its inclined position in figures 1 and 3, to the horizontal one seen in figure 2. Owing to the progressive action of the toggle joint bars, the rate of motion of the lever *N* is less rapid near the zero point (figure 1) than near the opposite extremity of the scale where *v* comes over 4, as in figure 2. It is easy to see that when instead of a gate a sliding valve is to be regulated, the bar *N* and the toggle joint levers *t t'*, may be used for that purpose. When both a steam engine and a water wheel are used in driving the same machinery, the cam and the toggle joint may be applied, as herein represented, and both operated by the same governor. In order to adapt the apparatus to the use of high and of low pressure steam, the cam *E* is made adjustable by means of the index arm *i* to different positions over the pressure arc *M*, on which are marks indicating the pressure of steam to which the action of the cam becomes adapted by setting the point of the arm *i* over the respective numbers. The point *f* is where the adjustable bar is connected with the cam. By means of the slot *u* and the regulator nut *R*, the point of the index *i* is made to assume the required position over the scale *M*. The axis *A* will, in consequence of the change or position of the index (from 40 to 60 for example), be carried farther away from the point *r* of the slot

s. In consequence of this change, the total opening of the valve will be less when the governor balls are at their lowest position, or when the governor, of whatever kind, is running at its lowest speed, than when the index *i* stands at 40 or at 50. In order to adapt the actions of the gate *G* to those of the valve *H*, when acting under different pressures of steam, the fulcrum *M* of the connecting rod *O*, may be transferred to the point *m'* when the index *i* is set at 40, or to *m''* when *i* stands at 60. At the same time the adjustable fulcrum support, *P*, must be so set as to lower or raise the fulcrum *n* so as to bring the cross line *g* to correspond with the mark 40, 50 or 60, set upon the support to which the screw *r* fastens the piece *P*. The numbers 50 and 60, shown on one and the same line, indicate that between those ranges the support needs no change of position with these adjustments—the gate and valve will be made to act simultaneously, and in such manner as to open rapidly near their open extremity, and slowly near the closed extremity.

I have herein spoken of the revolving pendulum governors, and have explained the operation of my invention in connection with the rising and falling of the arms of that kind of governor, but I wish it to be understood that whatever be the kind of governor used to open and close the valve, I shall, by applying my invention to transmit the action of the governor to the valve, gate, &c., to be governed, cause the rate of opening or closing of the valve, &c., near the full open end to be rapid, and the rate of opening or closing near the closed end to be slow, so as to prevent those alternations of too slow and too rapid speed which arise from the causes herein explained.

I wish it also to be understood that, though I have herein described only the cam and the toggle joint apparatus as means of effecting the purpose of my invention, yet that any equivalent machinery having similar progressive actions, may be substituted for the purpose of causing the action of the governor to effect the valve or other parts to be governed, rapidly at or near the open extremity, and slowly at or near the closed extremity, as hereinbefore explained.

Having thus explained my improvement what I claim as my invention, and

desire to secure by letters patent, is communicating the action of governors to the valves or other parts of machinery governed thereby, in such manner as to ease, by accelerating or retarding the motion of said valves, large amounts of regulating power to be added to or taken from the engine by a given change of the speed, when the motion of the engine becomes too much retarded, whether such retardation arises from increase of work or resistance, or from diminution of the tension of the moving force; and also small amounts of regulating power to be added to or taken from the engine by a like change of speed, when the motion is too much accelerated, whether such acceleration arises from diminution of work or resistance, or from increase in the tension of the moving force as herein set forth.

2. I also claim connecting the valve arm, or part to be regulated, to the regulator by a cam or its equivalent, having progressive rates of action, when the same is employed for transmitting the action of governors to the parts of machinery to be governed, and for the purpose of causing the motions of valves, gates, weirs, or other analogous parts, to take place rapidly for the regulation of low speeds, and slowly for the regulation of high speed, substantially in the manner and for the purposes herein set forth.

3. I also claim making the eccentric curve of the vibrating eam to vary its position with respect to its centre of vibration, for the purpose of varying the rapidity and extent of opening of the valve, according to the pressure of steam in the manner herein set forth.

—◆—

LANE'S IMPROVEMENT IN MACHINERY FOR
TURNING IRREGULAR BODIES.

Patent dated Feb. 25th, 1851. A. LANE,
Killingsworth, Conn.

Figure 1, is a side elevation; figure 2, is a plan or top view; figure 3, is an elevation of the frame and centres for holding the material to be cut, looking from the cutters; figure 4, is a transverse section of the material and one of the cutter shafts detached from the machine; figure 5, is a perspective view of one of the cutter shafts.

Similar letters of reference indicate corresponding parts in each of the several figures.

The nature of my invention consists in cutting any irregular form by means of any required number of cutters mounted on one or more rotary shafts or cylinders, each and all of the said cutters being formed so as to give the required form to the article to be cut or formed.

To enable others skilled in the art to make and use my invention, I will proceed to describe fully its construction and operation.

A A represents the frame of the machine, of suitable material, form and strength to carry the working parts. B is a shaft, hung in bearings *b b* on the frame, and carrying two circular heads or wheels; *c c'*, which may be of wood or metal, firmly secured at the required distance apart; *D D D D* are cutter shafts or cylinders, which may be of wood or metal; their axes are mounted in bearings *c c c c*, on the peripheries of the wheels or heads *c c'*; they are each provided with a series of knives or cutters, *a a a a*, arranged on different parts of their peripheries, in such a manner that all the edges of the knives on any cylinder or shaft will form a line, that line being the reverse of one edge of the profile of a longitudinal section, taken in one particular direction through the article cut when finished; and all the cylinders or shafts having their knives or cutters set to form the reverses of the different profiles of the article, which would come in contact with them during the revolution of the article and the shaft B at the same speed; they are each provided with one or more projections or ribs *d d d d*, extending nearly all round them, and forming guards for the rough material to bear against, being set slightly within the circle described by the edges of the cutters, so as to gauge the thickness of the chip cut, and prevent a jarring or tremulous motion of the material. E E represent a frame hung on pivots or axes, *e e*, which have bearings in the sides of the frame A A; it is movable at its upper end. F is a live spindle hung in bearings *f f*, attached to one side of the frame E E, and having a spur or chisel point; it is provided with a pulley *g*. G is a dead spindle secured to the opposite side of the frame to F, and having a conical point. H represents the article being cut, which, in this instance, is a hatchet handle. The cutter shafts and the cutters being formed

Fig. 1.

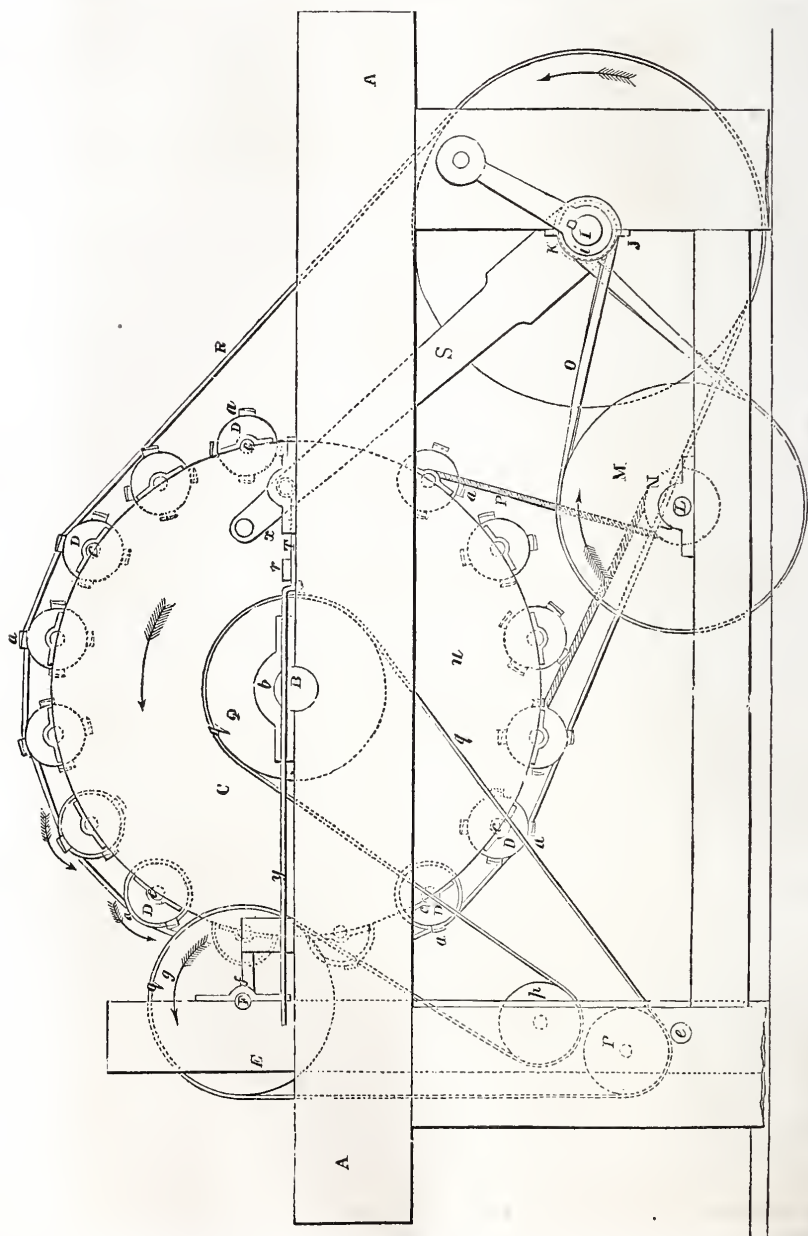


Fig. 3.

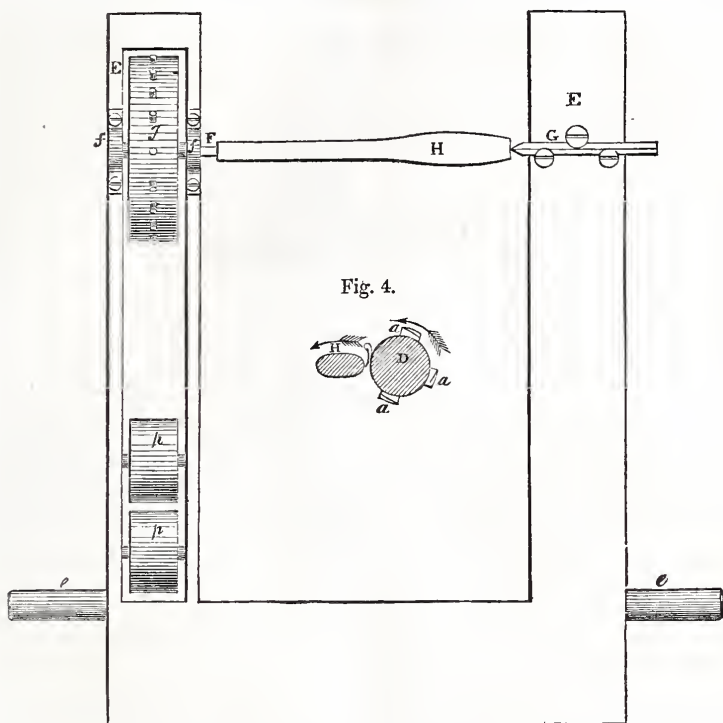


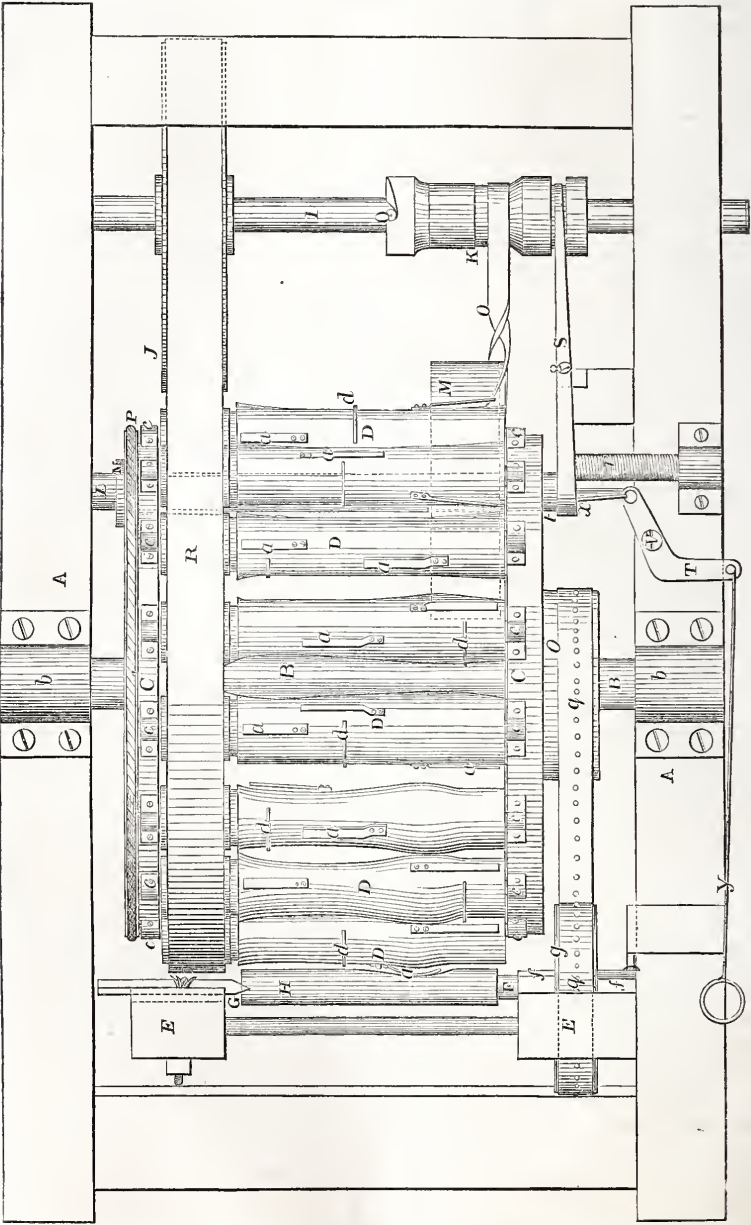
Fig. 4.



and set accordingly; it is placed between the points of the spindle *F* and *G*. *I* is the main driving shaft, which is mounted in bearings *i*, on the frame *A A*, and carries a large pulley *J*, and a small pulley *K*; *L* is an intermediate shaft mounted in bearings *l*, on the frame *A A*, and carrying the large pulley *M*, and small pulley *N*; *O* is a crossed endless band, running on the pulleys *K* and *M*, communicating motion from the driving shaft to the intermediate shaft *L*, and *P* is another crossed endless band, running on the pulley *N* and the wheels *c'*, communicating motion from the intermediate shaft *L*, to the shaft *B*, and causing the wheels *c c'*, carrying the cutters shafts, to rotate at a slow speed; the directions in which the shafts rotate are pointed out by arrows in figure 1; *Q* is a pulley secured on the shaft *B*; it is of the same diameter as the pulley *g*, on the spindle *F*; *q* is an endless band, passing over the pulleys *Q* and *g*, being guided by the guide pulleys *p p*,

on the frame *E E*; it gives motion to the spindle *F*, and to the article to be cut, in the same direction and at the same speed as the shaft *B*, the uniformity of speed being preserved by short pins or studs on the peripheries of the pulleys, which take into holes on the band; the band is passed over the guide pulleys *p p*, at the lower part of the frame, for the purpose of allowing the spindles *F* and *G*, to be thrown back to take out or put in the work without tightening or slackening the band; *R* is an endless band passing from the pulley *J*, over the cutter shaft, and giving those on which it bears a rapid rotary motion in the direction shown by the arrows in figures 1 and 4; the pressure of the band upon the cutter shaft, which is doing the work, may be increased by the application of friction pulleys, which may be caused by springs or weights to bear upon the outside of the band between the shafts nearer the work.

Fig. 2.



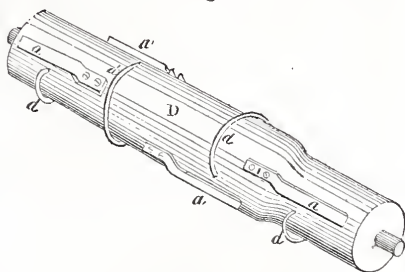
The pulley κ , on the driving shaft, which gives motion to the wheels $c\ c'$, is fitted loosely on the shaft, and only rotates with the shaft, whilst a notch on one end of it is brought in gear with a pin or stud o , on a shaft by a forked lever s , mounted on a fixed centre or pivot v , secured in an arm attached to the frame, the fork on the lever embracing a groove in the boss of the pulley; a helical spring r , attached to the frame, is always bearing on the upper end of the lever, and has a tendency to remove the pulley from the stud o , but is prevented by a stud or pin t , on the opposite side of the lever, which bears upon the side of the wheel and keeps the pulley to the stud, causing it to rotate with the shaft until the wheels $c\ c'$ have performed a revolution, when the stud t drops into an aperture u , in the side of the wheel c , and the lever s releasing the pulley κ from the stud o ; r is a lever working on a pivot, v ; it is attached by a rod x to the lever s , and has another rod y , attached at its opposite end, at the command of the attendant; this is for removing the stud t from the aperture u , and throwing the pulley κ in gear.

The operation of the machine is as follows:

Rotary motion being given to the driving shaft, will, through the pulley j and band R , be transmitted to the cutter shafts or cylinders at a high speed. The rough material being properly adjusted between the spindle F and G ; the operator, by pulling the rod y , will release the stud t from the aperture u , in the wheel c , and throw the pulley κ in gear: this, through the driving bands before described, will give a slow rotary motion to the wheels $c\ c'$, and to the spindle F , which, being secured at any convenient distance from the axes of the cutter shafts, is the fixed axis of the material. The wheels $c\ c'$, and the rough material rotating simultaneously, each of the cutter shafts is brought successively in contact with the material, and as it rotates on its own axis, will cut the material from end to end, leaving a profile the reverse of the form of the edges of the knives or cutters, each cutter shaft forming a side; thus forming a material into a figure having a number of sides equal to the number of cutter shafts employed. When the wheels $c\ c'$ have completed a

revolution, the aperture u will reach the stud t , which will fall into it; the lever s releasing the pulley κ from the stud o , will throw it out of gear, the band R still continuing the motion of those cutter shafts upon which it bears on their own axis; the article may then be taken out and will easily be finished off by other

Fig. 5.



tools or machinery. The requisite number of cutter shafts will depend on the form or description of the work to be done; fourteen or sixteen will cut an axe or hatchet handle sufficiently into shape; but for a shoe last thirty or forty would be required; the greater the number of cutter shafts employed the smoother the work will be cut, and the less finishing it will require.

Having explained the construction and operation of the machine represented in the drawings, I will further explain other modifications in the application of my invention.

Instead of forming one article at a time, as above described, several may be formed at the same time, by suspending them in the same manner, at different points around the large revolving wheels.

To facilitate and expedite the work, the large wheels, instead of rotating as described with uniform velocity, may by eccentric wheels be caused to move faster during the time when no cutter is operating upon the material. Instead of cutting the material to the required form at one revolution as described, it may be placed farther from the cutters, and a lighter cut taken, the material being gradually moved towards the cutters, and the large wheels and the material being allowed to perform several revolutions before the article is formed of the required size. In shaping articles having

nearly flat sides, as axe handles, &c., the cutter shafts, which are to cut the more flat sides, may be placed closer together than those which are to cut the rounder parts, by which the sides, left by the cuts of the different shafts, may be made of uniform width. The cutter shafts, instead of being hung on two wheels, or caused to revolve round a common axis, as described, may be hung on a frame horizontally or otherwise, and the material receiving rotary motion may be moved over each one successively in any convenient manner. If the opposite profiles of the longitudinal sections taken in various directions through the article are all similar in form as in a hammer handle, one cutter shaft only may be employed to cut the whole surface: the axes of the cut or shaft may be stationary, and the material hung on a frame precisely similar to *EE*, above described; to produce the transverse irregular shape, a cam may be attached to each side of the frame, at each end of the article to be formed, the said cams being of the form required for the transverse sections of the respective ends of the article. The cams being made to bear against firm supports on the frame, and to rotate simultaneously with the material, will cause the axes of each end of the material to recede from or approach the cutters, in such a manner as to give it the required shape, the material must have a continuous rotary motion, and the movable frame must be so hung as to receive a lateral vibratory motion; when the ends of the article to be formed differ in shape, when both ends are alike, one cam would give the shape to the whole length; the projections or *rids dd*, on the cutter shafts, gauging the thickness of the cut and preventing the cutters taking too deep hold at one time; the material and the cutter shaft may receive several revolutions before the article is cut to the required size, in this way the article will be cut with an even surface, instead of being left with a number of sides as described where the profiles of the various longitudinal sections were unlike.

If the opposite profiles of the longitudinal sections are all equal for a great part of the length of the article, as, for instance, a spoke for a wagon-wheel, one cutter shaft may be used to cut entirely round a part of the length, and the re-

mainder of the length may be cut by other cutter shafts. Instead of causing the work to receive a vibratory motion by cams as above described, the axis of the work may be stationary, and the vibratory motion given in the same manner to the cutter shaft or shafts. The whole of any common irregular form may be cut by one cutter wheel, the axis of both the cutter wheel and material being fixed; the material and cutter wheel being geared together so as to rotate at the same speed. In that case, the cutter wheel must be very large in proportion to the article to be formed, and a large number of cutters extending the whole length of the wheel either directly or spirally, or several series of shorter cutters, forming a continuous edge when in motion, must be used; the greater the number of the cutters employed, the smoother will be the surface of the article formed, until we have an entire cutting surface similar to a grindstone.

I do not claim merely the employment of two or more cutter wheels, or cutter shafts, or cylinders, provided with any number of cutters of any required form, for cutting the whole surface of and forming articles of any irregular form, without the use of the model of the article to be formed.

But I claim this only when the cutting cylinders are sustained, revolved, and carried to and from the block to be turned, by a revolving cylinder in whose periphery they are placed without any longitudinal motion, while the block revolves slowly, without any longitudinal or lateral motion, substantially as described.

MESSRS. CARNELL AND HOSKING'S TREBLE BEAT HYDRAULIC VALVES.

(From the London Mechanics' Magazine.)

Two varieties of these valves have been registered; one of which is represented in figs. 1 and 2, and the other in figs. 3 and 4. Figs. 1 and 3 are top elevations, and figs. 2 and 4 vertical cross sections.

A is in each case the valve seat; B, the valve; c c, the passages through the seat, and d d, passages through and around the valve; E is the guard or stop to prevent the valve from being thrown out of its seat by any sudden or unusual action of the engine.

Fig. 2.

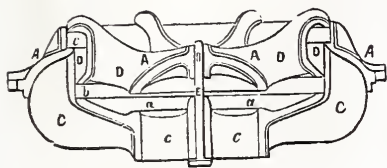


Fig. 4.

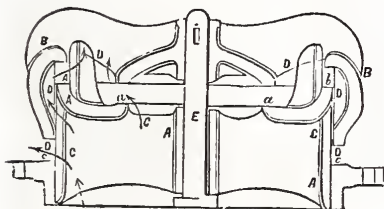


Fig. 1.

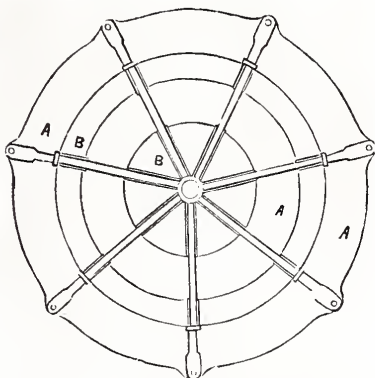
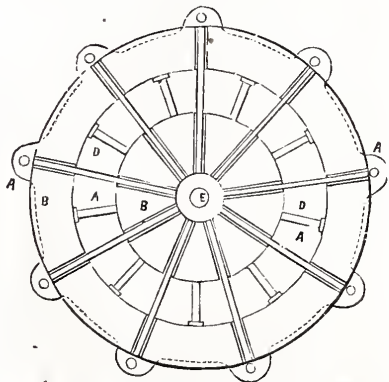


Fig. 3.



In figs. 2 and 4 the valve is shown in its open position, and the arrows indicate the course taken by the water in passing through it; *a a*, *b b*, *c c*, are the seats or bearing surfaces.

The most prominent advantage offered by these valves, is the larger opening for the passage of the water than is afforded by the valves of the forms hitherto in use, while at the same time the lift is reduced, and consequently the concussion very considerably lessened.

consists in an improved method of causing the packing of the piston of the plunger to fit to any inequality there may be in the diameter of the steam cylinder or pump barrel, which method affords at the same time great facilities for increasing the expanding pressure of the packing of the piston or pump bucket, during any temporary stoppage of the engine or pump, and without the trouble of taking the piston or bucket out of their places.

Figs. 1 to 14, inclusive, exhibit exemplifications of these improvements applied to the piston of a steam engine. Fig. 1 is a plan of a piston with my improved packing; fig. 2 a plan with the junk ring removed; fig. 3 a vertical section; and fig. 4 an elevation, partly in section, of one variety of this piston. The body, *A*, of the piston, and junk ring, *B*, are nearly

MILLS'S PATENT IMPROVEMENTS IN STEAM ENGINES AND IN PUMPS.

Specification.

My invention, in so far as regards improvements in steam engines and pumps,

Fig. 1.

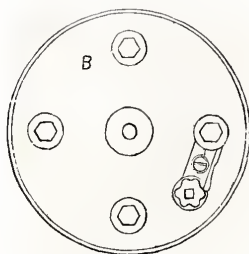


Fig. 5.

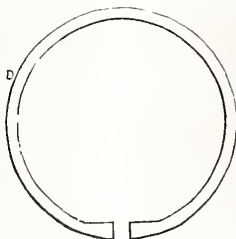


Fig. 12.

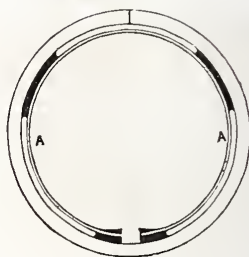


Fig. 2.

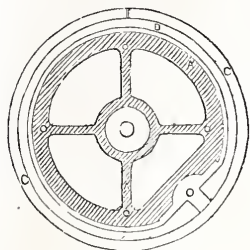


Fig. 6.



Fig. 13.



Fig. 7. Fig. 8. Fig. 9.



Fig. 15.

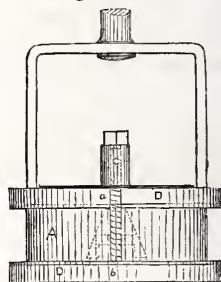


Fig. 3.

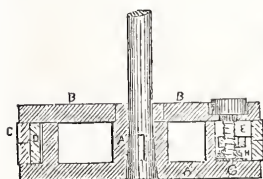


Fig. 14.

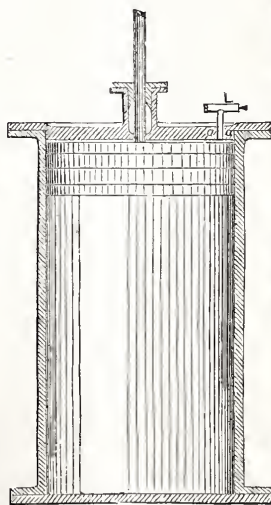


Fig. 10.

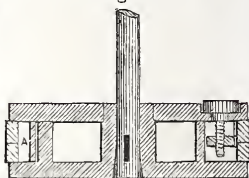


Fig. 4.

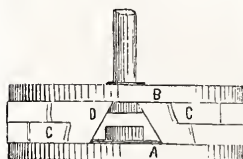
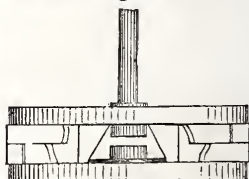


Fig. 11.



similar to those of the common pistons now in use. *c c* are the packing rings, and *d* an inner ring, which is nearly of the same depth as the two packing rings, and is turned, or otherwise finished, so as to bear uniformly with its exterior surface upon the inner surfaces of the packing

rings. The ring *d* has an angular portion cut out of it, as represented in the plan and elevation given separately is figs. 5 and 6; into which angular space there is fitted a wedge, *E*, by which the ring is made to expand to an extent sufficient to cause it to bear against the packing rings.

Fig. 7 is an elevation, fig. 8 an edge view, and fig. 9 a plan of the wedge-piece: E, F is a cavity formed in the wedge, E, which serves for the reception of a nut, G, and spiral spring, H, which is superimposed between the nut and the wedge, E. The spiral spring, H, exerts a constant upward pressure upon the wedge, and this pressure can be increased to any desired extent without undoing the piston, or even having to remove it from the cylinder, by simply turning the screw, I, so as to compress the spring. The screw, I, passes through the junk ring and terminates in a rose-formed head. K is a spring catch, which is fixed to the junk ring, and by taking into the notches of the rose-head prevents the screw from turning round. (The wedge-shaped piece might be used without the spiral spring; but not so advantageously.)

When pistons of this improved construction are employed in horizontal and oscillating steam engine cylinders, then the back of the wedge-shaped piece should be bevelled as shown at *a a*, in fig. 9, and the recess in the piston, into which the wedge-shaped piece is fitted, should have a corresponding bevel cut upon it, so that as the wedge is pressed upwards (in course of the wear of the parts) these two bevelled surfaces may still keep in contact, and thus give firmness to the piston; the advantage of this arrangement will be more especially experienced when the wedge is put at the lower side of the piston in horizontal cylinders. In oscillating cylinders, the wedge is most beneficially placed on that side of the piston immediately opposite to the throw of the crank after it has passed the top of the stroke.

Fig. 10 is a cross section, and fig. 11 an elevation, partly in section, of another steam engine piston, with a somewhat different arrangement for causing the packing to expand. Fig. 12 is a plan of the packing and expanding rings, separate from the piston. Fig. 13 is an elevation of the expanding ring, which is composed of a thin band or hoop of steel, A, upon which there are fitted several bearing-pieces, B B, which press upon the packing rings. The steel band, A, acts as a spring, which yields in the event of the diameter of the cylinder requiring a corresponding expansion or contraction of the piston to take place, during the act of

making a stroke, so that the wedge-shaped piece in this case requires no helical spring.

Fig. 14 represents the section of a cylinder and cover, containing a piston: *a*, in the cover, shows an orifice through which a key, L, may be introduced, for the purpose of turning the screw, I, whereby the spiral spring may be made to act upon the wedge piece. By this means it is considered that the piston may be adjusted at any time, with a delay of only a few minutes' working. The orifice, *a*, is to be stopped by means of a screw.

Fig. 15 is an elevation of a pump bucket constructed upon a similar principle to the pistons before described. This bucket is constructed for being fitted with a hempen packing, upon which the expanding ring, A, may act, instead of acting upon a metallic packing. D D are two ledges or collars, which are bevelled upon their inner edges, as indicated by the dotted lines, *a a*, *b b*, so as to cause the hempen packing, as it is made to expand, to become more compact upon the outer surface, where it comes in contact with the pump barrel.

Claim.—First. The constructing of pistons, for steam engines and pumps, with an expanding ring, acted upon by a wedge-shaped piece acting parallel to the line of motion of the piston, as exemplified by figs. 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Second. The two several modifications thereof, exemplified by figs. 10, 11, 12, 13, and 14. Fig. 14 is not included, as the modification is too slight to justify notice.

And Third. The construction of hempen packed pump buckets, and other pistons, in the manner shown in fig. 16.

The desideratum of a perfect contact between cylinder and piston, and the continuance of this perfect contact, is, from the nature of things, scarcely to be hoped for. We have many metallic packings which answer on paper *remarkably* well, and many which in practice answer well; but we have yet to see one which will adjust itself, without additional friction, to the inequalities of wear growing out of the different densities of the parts under action.

for driving the same; and in the construction of the perforated drums.

The above engraving exhibits an elevation and section of the improved centrifugal machine, adapted for carrying into effect the object of the first part; that is to say, the separation of small fragments of the cane from saccharine juice, previous to the succeeding operation of depurating the juice, to separate it from coagulated matters found therein. Fig. 1, is an elevation of the first improved machine; and fig. 2, is a vertical section thereof, taken through the centre shaft: *a a*, is the external casing for the reception of the juice, as it passes through the separating drum. This case is furnished with a conical bottom, *b b*, which conducts the juice to the centre at *c*, for the purpose to be hereafter described; *d d*, is the perforated drum, supported on a vertical shaft, *e*, as in ordinary; it is affixed to the shaft by attaching the bottom to a central flange, *f*, and also by a cone, *g*, which serves to strengthen the support of the drum; and to fill the centre thereof, to the exclusion of the materials operated upon in the drum. The drum, *d*, is formed slightly conical, in order to facilitate the introduction of fibrous material between two thicknesses of perforated metal; the inner thickness of metal is fixed to the bottom, *b*, while the outer thickness is placed over the fibrous material, and drawn downwards by means of lacing; the increasing diameter towards the bottom causing the fabric to be firmly compressed between the two. The shaft, *e*, is driven by means of the friction pulleys, *h h*, one of which is on the driving shaft, *i*, supported on bearings, *k*, mounted on an arm of a trivet frame, *l*. This shaft also carries a band wheel, *m*, by which motion is simultaneously imparted to the wheel, *n*. This wheel, although supported on the shaft, *e*, is not affixed thereto, but to a socket, *o*, fitted to that shaft. The arm, *p*, formed hollow, for lightness, and triangular in cross section, for strength, is attached to the socket, *o*, which carries inclined segmental scrapers, *q q q*, formed of a like radius as the drum, *d*, and so disposed as to approximate, without, however, touching the interior of the drum. The object of these scrapers, *q q q*, is to prevent any of the materials, that do not pass the perforated drum, adhering there-

to, and also, at the same time, to lift them up out of the drum. Motion being given to the shaft, *i*, by throwing the strap from the loose to the fast pulley, at *r*, and the supply of the cane juice admitted by the pipe, *t*, the action of the machine will be thus:—The rapid rotation of the drum, *d*, will cause the fluid portion of the juice to pass through the perforations, while the small pieces of cane will be retained within the interior of the drum. The band giving motion to the wheel, *n*, is crossed and guided by turning pulleys, so as to drive the arm, *p*, and scrapers, in the same direction as the drum; but the wheel, *n*, being of less diameter than the wheel, *m*, it follows that the arm, *p*, will travel faster than the drum, and, consequently, to gain upon it during its motion. This excess of motion causes the scrapers, *q*, to pass over the entire inner surface of the drum, thereby removing any adhering particles therefrom, and causing the mass of such to be raised upon the inside of the drum. The continual motion of the scrapers will finally cause the accumulated mass to be lifted above the top of the drum, when they will fly off, by reason of the centrifugal force, and be received by the guard, *s*, and fall to the ground. The differential motion of the scrapers and the drum, as before mentioned, cause the mass of matters retained, to be lifted up, the centrifugal force maintaining their elevated position until the subsequent return of the scrapers, when the whole is lifted a stage higher, until expelled as explained. On the lower end of the shaft, *e*, a centrifugal disc pump, *w*, is fixed, having its central opening immediately under the opening, *c*, through which the juice descends; this pump participating in the rapid rotary motion of the drum, throws the juice into the casing, from which it is conveyed to any part of the building by the pipe, *v*, the pressure created by the pump, *w*, being sufficient to raise the liquor to any height desired.

[This pump forms the subject of a patent previously obtained by the present patentee.]

The second part, which refers to the depuration of sugars, may be effected by the foregoing centrifugal machine, modified for the purpose, by others to be hereafter described, or by the ordinary methods now in practice.

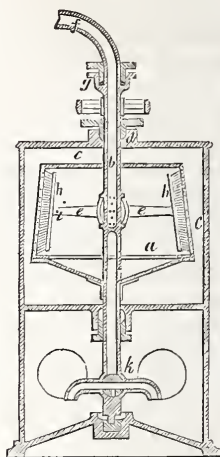
The third part refers to a mode of increasing the evaporating surface of sugar, by dispersing it in a shower, while in a heated state, in order the more rapidly to evaporate the aqueous particles.

The apparatus employed for this purpose, is very similar to the ordinary centrifugal pump; and consists of a vertical pipe, stepped and placed in the centre of an evaporating pan. On the top of this pipe, is placed a double conical vessel, or disperser, preforated on the periphery, and with its larger diameter upwards. This pump having been filled, a rapid rotary motion is communicated thereto, by a band, or other means; the liquor in the enlarged conical part emerges from two perforations, which causes a flow up the pipe from the pan. The perforations at the upper and greatest diameter, project the syrup to the greatest distance; while the liquor passing from the lower perforations falls near the centre, thereby spreading it uniformly over the surface of the pan; in which it falls, to be again raised by the pump. A ball valve placed near the foot of the upright pipe, prevents the syrup returning, when the machine is stopped. The liquid contained in the lower end (which is not perforated) of the truncated cone, serves to give the centrifugal force, necessary to again cause the ascent of the juice, when the pump is set in motion. A current of air passing through the shower of juice facilitates the operation.

The fourth part of this invention has reference to apparatus for the application of centrifugal force to the filtration of syrups, for the separation of coagulated matters therefrom, after the process of "blowing up." This apparatus is somewhat similar to that shown at page 270, but is without the centrifugal forcing pump; the machine for this purpose is not fitted with the shield or guard, as in this case the separated matters are not thrown off from the drum as before. The drum of this machine is of two different diameters, having an addition to the top of a larger diameter than the body, or that part in which the scrapers are situate. The coagulated matters as they are intercepted and retained by the drum during its rotation, are carried up as before, and when raised above the

upper edge of the smaller part of the drum, it is thrown into the larger part, by which it is retained until a sufficient quantity accumulates for removal, when the machine is stopped for that purpose;

Fig. 3.



the syrup is collected by the outer casing, and conveyed by a pipe to the charcoal filter, or otherwise disposed of. Some little difference exists in the arrangement of the driving gear, this machine being represented as actuated by band pulleys, for both drum and scrapers, the differential motion producing the action of the scrapers as before. In some instances, in the filtration of syrups, it is desirable to exclude them from contact with the atmosphere as much as possible, as the patentee finds that the action of the air deteriorates the quality of the sugar.

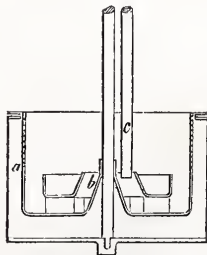
Fig. 3 represents a vertical section of a centrifugal apparatus for this purpose; it consists of a drum *a*, of the construction before described; it is mounted on a hollow axis, *b*, which emerges from the upper and lower parts of the casing, *c c*, through stuffing boxes, *d d*, and is fitted at the top with a strap rigger or other means of communicating rotary motion thereto. The drum *a* is securely fixed to the shaft *b*, and consequently revolves with it. On the interior of the drum *a*, two radial arms, *e e*, are placed, which carry brushes, *h h*, for the purpose of removing any coagulated matter that may adhere in the perforations of the drum;

f is the supply pipe for the delivery of the syrup, which pipe is united to the shaft, *b*, by a stuffing box, *g*, and remains stationary, while the shaft, *d*, is driven by a strap rigger; the syrup, as it flows down the shaft, *b*, enters the boss of the arms, *e e*, by the apertures in the shaft, and thence escapes at openings, *i i*, in the extreme ends of the arms, *e*; these openings, *i i*, are situated on the opposite side of the arms, so that the liquid, on emerging therefrom, may tend to force round those arms; the syrup thus admitted to the drum will be acted on by the centrifugal force of the rotating drum, and escape through the perforations into the casing, *c*, in which it is collected and transmitted by suitable communications to the receptacle desired. The coagulated matters retained in the drum are removed from the interior by the brushes, *h h*, and conducted by the conical bottom of the drum into the lower part of the shaft, with which these are in communication. The lower part of the shaft, *b*, is furnished with a stop-cock, *k*, which is opened occasionally on an accumulation of coagulated matters taking place; these matters are permitted to run out by stopping the machine, in order to allow them to descend from the periphery of the drum to the lower part of the shaft. Hand-holes are made in the lower part of the casing, to permit the introduction of the hand, in order to turn the tap, *k*. The lower part of the casing also serves as a collector for the coagulated matters, which are conveyed thence by suitable communication. In working this machine, the casing, *c*, will deliver the syrup to a higher level than the drum is situated, by reason of the centrifugal force of the syrup ejected by it. It was before mentioned that the drum arms were loose on the shaft, *b*; they will, however, revolve with the drum, but with additional speed due to the height of fall of the syrup which escapes by the apertures, *i i*, as before mentioned, producing a driving power on the principle of Barker's mill. The syrup, having been thus treated, will be conveyed away by a close pipe to a suitable receptacle, and be prevented coming in contact with the atmosphere during the operation.

The fifth part of this invention refers to a variety of modifications of the centrifugal drum apparatus, for the purposes

of sugar manufacture, with a view to facilitate or improve the manufacture, for the application of power thereto, and for the prevention of injurious results to the buildings in which such machines are placed. Fig. 4 represents a vertical section of a centrifugal drum, in which the matters separated from syrups are ejected from the machine by the centrifugal force alone, according to the supply of syrup admitted to the drum, which is regulated by a stop-cock on the supply pipe. The centre of the drum, *a*, is provided with the conical centre filling piece, as before; concentric with this, another conical shield, *b*, is placed, between which and the centre cone the supply of syrup is admitted by the pipe *c*. The partition, *b*, is supported on a series of radial vanes, which carry the syrup round, and causes it to be thrown towards the circumference of the drum. The apertures of this drum commence from below, on a level with the outer edge of the centre piece, *b*; the syrup must therefore rise to that point before any escapes. The matters intercepted and retained by the drum will thus always rest on the fresh supply of the syrup. The centrifugal force of the syrups, having egress to the drum, will force up the separated matters, which, on arriving at the top of the drum, will be thrown off, and received in some suitable receptacle surrounding the drum. By regulating the supply of the pipe, *c*, the matters separated from the syrup will be allowed to remain a longer or shorter period of time, under the centrifugal action of the drum.

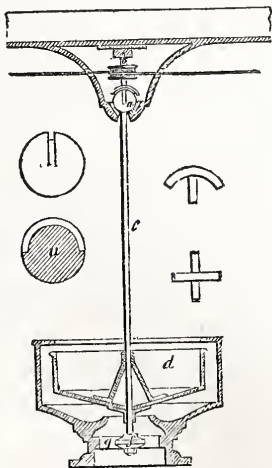
Fig. 4.



An arrangement of apparatus is shown at fig. 5, in vertical section, for the purpose of preventing the vibratory motion,

resulting from the unequal load of centrifugal machines, being communicated to the building in which it is situated. The drum for this object is suspended from the flooring above, the upper part of the shaft having a ball joint or bearing, *a*, for the suspension of the drum, and the transmission of motion thereto. This ball, *a*, is connected by two segmental pieces, placed across each other, as shown in enlarged views. The upper segment fits into a channel cut in a cup piece attached to the driving shaft, *b*, while the cross segment fits into a like recess in the ball, *a*. This permits the free oscillatory motion of the shaft, *c*, and the suspended drum, *d*. Motion is represented as being communicated by a band or cord, but gearing or other means may be resorted to. The casing, which receives the syrup from the drum, is placed and fixed on the floor beneath, and also restricts the obicular motion of the drum. For this purpose, a pulley, *f*, is placed on the lower end of the shaft, and surrounded by a surface, *g*, which, with the pulley, comes in contact, on any excess of the obicular motion of the drum taking

Fig. 5.



place, and confining such motion within certain limits. The periphery of the pulley is further covered with leather, or some soft material, to lessen the effect of any blow that may result.

Another improvement consists of an

arrangement of a centrifugal apparatus, adapted for permitting the removal and change of the rotating drums, for the purpose of changing the matters to be treated. This is represented at fig. 6; a conical centre piece, *a*, is fixed to the shaft, *b*, which is driven from below. The centre of the drum is made to fit and rest upon the centre, so as readily to admit of removal, as described, when required for the purpose of changing the matters to be treated.

Another improvement is exhibited in this figure, which consists of the form of bottom, which is adapted to receive and contain the charge of syrup to be acted upon, previous to the drum being put in motion. In this machine the obicular motion of the drum is, in some measure, counteracted by supporting the shaft in a hemispherical step, and in case of transmitting the motion by gearing, to communicate the same by the cross segments before described. The upper bearing of the shaft is placed in the centre of a block of vulcanized india-rubber, *c*, the yielding of which to the vibratory motion of the drum, prevents it being communicated to the building. Instead of the india-rubber, a roller may be placed on the shaft, and confined within certain limits, as before explained at fig. 5.

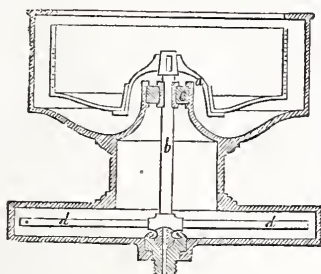
The drum in fig. 6 is represented as being driven by means of the simple emissive engine, the arms, *d d*, of which are placed on the same shaft as the drum; the steam passage is up the centre of the ball step, as clearly seen, the engine acting by the emission thereof, at opposite apertures, is well understood. The upper part of this engine casing is sunk level with the floor, to obviate any inconvenience in getting at the machine.

Another improvement in the casings of centrifugal machines, consists in contracting them at the base, for the better and more convenient approach of the workmen.

Another improvement consists of a peculiar formation of the shafts of centrifugal machines, which are very liable to become broken, from the unequal load to which they are subject. To obviate this, the shafts, or centres, are made of hollow cones of plate iron, fixing the drum at their largest diameter. Two cones are placed base to base, for the purpose, the apices forming the bearings on which it

rotates; a strengthening ring is placed in the upper and longest cone, from which radial rods are extended to the upper periphery of the drum. In driving centrifugal machines, the patentee places them in pairs, with friction wheels on the lower ends, which take on to the periphery of a fly wheel placed horizontally between them. This wheel forms the fly wheel of a small oscillating engine, connected directly to a crank on the shaft of such wheel; the friction pulleys are forced up to contact by springs, their bearings being fitted to slides for that purpose.

Fig. 6.



Another mode of suspending the centrifugal drum is represented, in which the centre cone of the drum rises high above the periphery, so as to surround a pedestal on which the cone rests at the top. A ball joint, such as before described, is employed to support, and at the same time to communicate motion to the drum. The pedestal support, which is also conical, rises from the bottom of the casing or vessel containing the drum, and is considerably smaller than the centre cone of the drum, in order to allow the oscillating motion thereof; the drum shaft is driven from below by a strap pulley, or other suitable means.

A mode of counteracting the vibratory tendency of centrifugal drums is represented, in which the horizontal position of the drum is always maintained with certain freedom, to swerve on account of the inequality of the load; for this purpose, instead of supporting the drum on a single ball joint, it is supported on three ball joints, ranged round the shaft at equidistant points; this support is on a level with the drum, within a large central cavity; a disc is fixed on the top of the shaft, which

supports the three ball joints; these ball joints consist of three short rods, having a ball at either end, with a spherical enlargement near the upper end; this spherical enlargement is sustained in cap rests, on the disc fixed to the shaft, while the drum is supported on the three upper balls; these rods assuming a vertical position, a counter balance weight is suspended from the three ball rods, and rests on the ball end at the bottom. This weight is in the form of a ring, and surrounds the driving shaft, and by its gravity, and the leverage it has over the drum, tends to maintain the central position thereof, but permits it to become eccentric in a certain extent to the driving shaft. The greater distance the drum is deflected from its central position, the greater will be the leverage obtained by the ring weight, as the ball rods by which the weight is suspended are considerably longer than the upper ends which support the drum.

The last part of this invention has reference to the perforation of centrifugal drums. Instead of forming them of wire cloth, the patentee perforates, in a peculiar manner, a sheet of metal constructed of a cylindrical or other circular form. In order to produce the perforations required, a series of grooves are turned in the periphery, about half way through the metal. Grooves are then formed at right angles thereto, on the other side of the metal, so as to cut into the grooves previously made. Wherever these grooves intersect, an aperture will be produced for the emission of the liquid as desired.

Another improvement in perforating consists in producing a series of conical holes, bored from the outside, by which any grains entering the smaller aperture inside will have free egress, and will not be liable to stop the perforations, as is the case with parallel holes or perforations. In using wire cloth as a filtering medium, the patentee prefers that it should be passed through a pair of rollers, in order to flatten the crossing of the wire,—this having the effect of preventing the accumulation of matters adhering to the wire cloth, thereby partially stopping the action of the machine, as is the case at present.

In conclusion, the patentee observes, that he has described many parts of

centrifugal machines and apparatus, which taken separately, are not new, and that, therefore, he does not claim such as his invention, and that he does not confine himself to the precise modification or combination of parts herein shown, so long as the essential features of the various parts of the invention are retained,—but he claims as his invention—

First—The apparatus described under the first part of this specification, for the purpose of separating the fragments of cellular tissue from cane juice, and the coagulated or other matters also from cane juice, but after the process of defecation.

Secondly—The centrifugal apparatus, for the purpose of increasing the evaporation of saccharine fluids, by raising and allowing them to fall through a current of air, as described.

Thirdly—The mode described of suspending the shafts and drums of centrifugal machines for curing sugar, and the method of connecting such shafts with the first mover, and also the mode by which their obicular motion is restrained within certain limits, and also the mode of suspending the drums of centrifugal machines on an universal joint, as described.

Fourthly—The use of elastic packing between the bottom of centrifugal machines and the floor on which they rest, for the purpose of lessening the amount of vibration transmitted to the building in which they are worked.

Fifthly—The use of leather bushes to the spindles, and of vulcanized india-rubber rings surrounding the bushes, in which the axle revolves, for the purpose of lessening the tremor in centrifugal machines, for curing sugar.

Sixthly—The apparatus described for separating the coagulated and other matters from syrups, in the refining of sugar.

Seventhly—The removing of the drum from the machine, for the purpose of discharging it of its contents, thereby admitting of its being replaced immediately by another drum ready charged with fresh materials to be operated upon, together with the furnishing such drums with lower receptacles or dishes, wherein the material is retained previous to the rotatory motion being communicated thereto, and also the apparatus described for that purpose.

Eighthly—The discharging the sugar from centrifugal drums, by the aid of centrifugal force alone, as described.

Ninthly—The method of constructing the axis of centrifugal machines, of cones of sheet iron.

Tenthly—The mode of supporting the drums of centrifugal machines on universal joints, with a balancing ring, as described.

Eleventhly—The mode described of forming the perforated drum for centrifugal machines, by grooving it internally and externally, at right angles, in the manner described, and also perforating such drums with conical holes.

Twelfthly—The use of the axis of the revolving drum in centrifugal machines, as the axis of an emissive engine fixed thereto, for the purposes described.

Thirteenthly—The mode described of keeping open the perforations of the drum of centrifugal machines, by a wire or other suitable brush.

PIRSSON'S PATENT STEAM ENGINE CONDENSER.

Patent dated July 31, 1850. Patentee, JOSEPH POOLE PIRSSON, of New-York, Civil Engineer.

We noticed the successful adoption, on board the American steamer *Osprey*, of a new description of condenser, invented by Mr. J. P. Pirsson, of New-York. It has been in continued use in that vessel (of 1,000 tons burden) for about twelve months; and when the boilers were recently examined, there was not the slightest scale or deposit to be seen. The condenser itself, too, was in excellent order. We now lay the specification of it before our readers:—

Specification.

Fig. 1 is a side elevation; fig. 2 is a top view; fig. 3 is a longitudinal section. Figs. 4 and 5 are views showing variations in the construction of the same apparatus. Fig. 6 is a view of a common condenser.

To condense steam to water, it must be brought in contact with some element of less temperature than itself; and the extent and rapidity with which it can be effected, will be as the difference of temperatures and the conducting quality of the condensing element. The usual

Fig. 1.

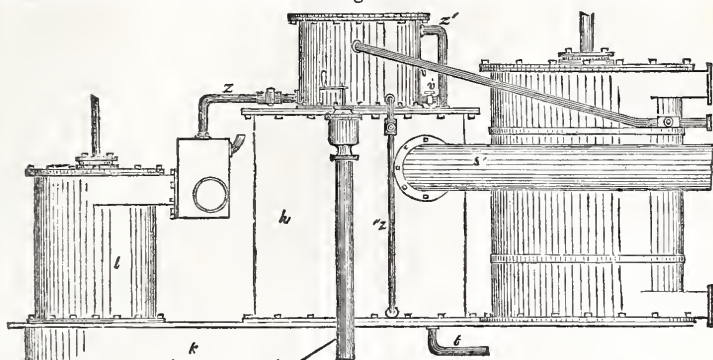


Fig. 2.

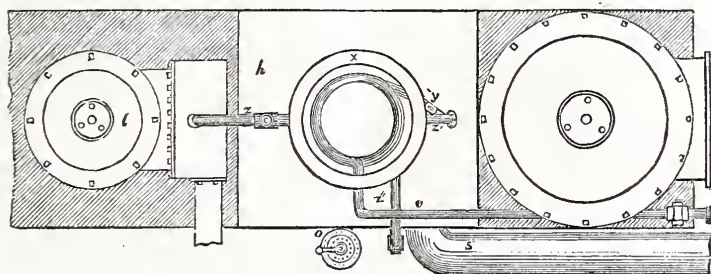
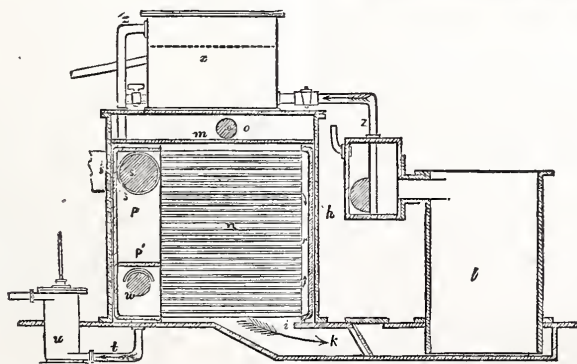


Fig. 3.

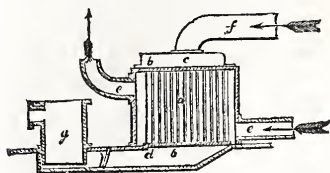


modes of condensing steam, where it is used as a motive power, are by allowing it to escape into the air; by injecting it into a vessel or vessels which are kept at a low temperature by immersion in cold water, or a current of air, the steam being cooled by contact with the metal; and by injecting it into vessels in which it is

brought in direct contact with a jet of water. In the first instance, the water resulting from the condensation of the steam is lost; in the second, it is retained in the vessel in which it is confined, unmixed with any other substance; in the third, it is retained, but is mixed with the water used for condensing it. Con-

condensing engines are those which employ one or the other of the two last described plans. In marine engines, or where salt or other impure water is employed for condensing the steam, this latter plan involves the loss of the fresh water resulting therefrom, in a manner well known, and consequently either the boilers must be supplied with bad water, or a supply of pure water must be specially provided.

Fig. 6.



In most cases this cannot be accomplished, as it has been found impossible to carry a sufficient quantity to last for any great length of time.

This being the case, attention was early (in the history of the steam engine) given to perfecting the second mode named herein—viz., the condensing of the steam by radiation in closed metallic vessels, kept submerged in water. In this plan the boilers are to be first filled with pure water; the steam being condensed back to water, is thus caught and returned to the boilers, to be used over and over again; the leakage and waste being supplied from reservoirs provided with an extra quantity, or by distillation. The steam being condensed in vacuo, the external surface of these vessels is thereby subjected to the pressure of the atmosphere, and also to the pressure of a column of water, proportioned to the depth at which they are immersed. In fig. 6 is a view of the usual mode of constructing this kind of condenser; *a* is a cluster of pipes (that being the best form to resist pressure) inserted in two flanges, *b*; the ends of the pipes are covered at *c* by a cap, and at *d* by the channel in the bed-plate; *e* is a tank to hold the water for condensing, which flows in and out as indicated; *f* is the exhaust pipe for conveying the steam to be condensed; *g* the air pump. The steam is thus condensed by coming in contact with the cold surface of the metal, the pump, *g*, maintaining the vacuity of the pipes by removing the water as fast as it accumu-

lates in the channel *d*, and also any air or other gases. Hence the external surfaces of the tubes are subjected to the pressure of the air, and also to that of the column of water in which they are immersed, as before named. This mode of condensing steam has these difficulties to contend with, and which have hitherto been found insuperable. The alternate heating and cooling of the metal pipes, consequent upon the periodical injections of the steam, causes a series of expansions and contractions to be continually going on. In addition to this, the great pressure upon them soon produces fractures in the various joints and seams, which at once destroys the whole operation, as the vacuum can no longer be maintained from the flowing in of the air, and also of the water, which is fatal to the whole operation.

Having thus stated the peculiar character of the old modes of condensing steam, I shall now proceed to describe my improvements and to set forth wherein they differ from all others.

At the letter *h*, fig. 3, is represented a box or case composed of metal, and of sufficient strength to resist the pressure of the atmosphere, and is also to be made as perfectly air and water-tight as possible. In the under side of the box *h*, there is an opening *i*, through which a connection is made by a pipe or channel *k*, with an air-pump *l*, of common construction, as shown in section, figure 3. At *m* is a perforated plate, on which the condensing water is received, and is for the purpose of dispersing it in a manner well known. A pipe and cock are attached for injecting the water for condensing the steam. Into the box thus constructed, I next introduce a radiating condenser, that is to say, a vessel or apparatus in which steam is to be condensed by contact with cold metallic or like surfaces, which I make as follows: At *n*, figure 3, is seen a number of tubes arranged horizontally, their ends being fixed in plates or flanges of metal, having holes perforated to receive them; next I cover the ends of the tubes by attaching caps, *p* and *r*, to these plates, as shown in section, figure 3. The tubes thus arranged, are introduced within the box *h*, as shown. In the cap *p* there is an opening made at *s* to receive the end of the pipe which conveys the steam to be condensed, which pipe is seen at *s'*. The

Fig. 4.

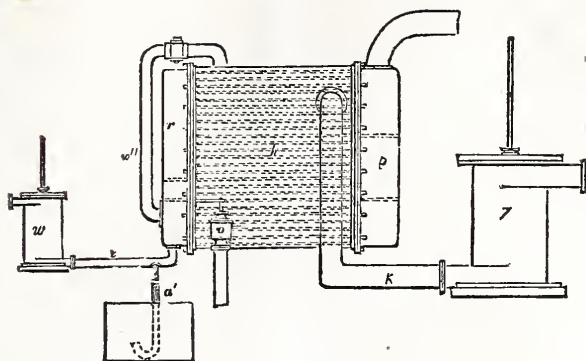
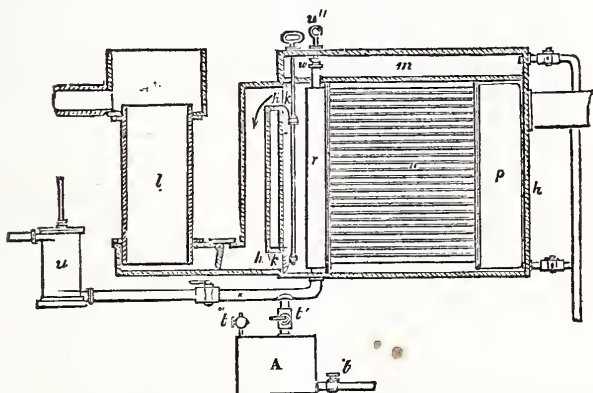


Fig. 5.



steam pipe s' is bolted to the outside of the box h by a flange, the end passing through and made to enter the cap p , through the hole s , as shown. The cap p is divided into two compartments by a partition p' , the object of which is to cause the steam to traverse through two sections of pipes. More partitions may be introduced, or any other arrangement may be adopted to insure full and equal distribution of the steam to each pipe. At t is shown a pipe connected with the lower side of the cap p , which passes through the box h , having a tight joint where it comes out. This pipe terminates in a pump u , the use of which is to pump away the water resulting from the condensation of the steam, and which collects in the bottom of the pipes and caps. At w is an opening in the lower

division of the cap p , which forms a passage from the pipes to the interior of the box; the use of which will be described more fully. This opening, w , is to have a door or valve over it of common construction, which may be opened or closed by a handle from the outside of the box h , the handle working through a stuffing-box in h .

I have described this part of my invention as being made of tubes or pipes chiefly; but it is obvious that other forms may be substituted,—as sheets of metal, coils of pipe, &c.

The operation of this part of my invention is as follows:—The engine being started in the usual manner, the exhaust steam flows through the pipe s^1 , into the cap p , and thence into the cluster of pipes n ; at the same time a jet of cold water

is admitted through the injection cock *o* on the perforated plate *m*, from which it falls in a shower upon the pipes *n*, and thus, by a well-known law, at once condenses the steam—the water resulting being collected in the bottom of the pipes and caps—the large pump *l* removing the condensing water as fast as it accumulates from the box *h*, and maintaining the vacuum,—the smaller pump *u* removing the water resulting from the condensed steam. In like manner, the condensing water is allowed to flow off as fast as discharged from the pump *l*, but the water taken from the pipes is retained for the feed to the boilers. The use of the aperture *w*, is for the purpose of maintaining an equal pressure on each side of the pipes, or rather to prevent them from being subjected to any pressure, either internal or external. This can be made apparent as follows:—Supposing the orifice *w* closed, and cold water admitted in quantity sufficient to condense a part of the steam only, it will be evident that the vacuum in the box *h* will be better than the vacuum in the pipes, and the difference will be as the volumes of uncondensed steam. Now if we open the door or valve over the aperture *w*, a portion of the steam in the pipes will at once rush through and extend itself throughout the box *h* until an equilibrium is produced. So long as the steam is fully condensed, and also the operation of the pumps *l* and *u* equal, then, of course, the radiating condenser *n* will be subjected to the same pressure, both external and internal; or, rather, will not be subjected to any, even if the orifice *w* be kept closed. The use of the opening *w*, therefore, is to insure the preservation of the equilibrium in cases where the steam is not fully condensed, or where the pumps fail to work equally. The atmospheric pressure being sustained by the box *h*.

Having now described the principal elements of my condensing apparatus, except some of its modifications (to be mentioned hereafter), I will next describe an apparatus for making up any deficiency in the supply of pure water which may arise from leaks and other means of waste. At *x*, figures 1, 2, 3, is seen a tank, standing upon the top of the condensing box *h* (but may be put in any other convenient place). This tank must be air and water-tight, and also capable

of sustaining the pressure of the atmosphere. At *y*, fig. 2, a steam pipe is attached, which may terminate on the inside in a coil or cluster of pipes, or other chamber for holding steam, as shown. The lower end of this coil terminates in a pipe, which passes out through the side of the tank at *y'*, and empties into another pipe, as shown. *z* is a pipe attached to the lower side of the tank *x*, the opposite end of which terminates in the "hot well" of the air pump *l*, or other reservoir containing a supply of the water to be evaporated; *z'* is a pipe attached to the upper side of the tank *x*; it is bent so as to pass down through the top of the box *h*, to which it is bolted by a flange, the end terminating so as to discharge into the cap *p* of the inside condenser, as shown; *z''* is a pipe attached to the tank *x*, near its bottom, by one end, and by the other to the box *h*, so as to discharge into it. To put this apparatus in operation, the engine is first set in motion, and the condensation of the steam going on, the vacuum of the box *h* will be communicated through *z'* to the tank *x*, the interior of which will consequently be in vacuo. The cock to the pipe *z* being opened, water from the hot well of the pump *l* will flow into *x* by the pressure of the atmosphere; the tank is to be filled sufficiently to cover the coil of pipes, or as seen at the dotted lines. Next, steam is to be admitted through *y*, the cock *y'* being kept closed (except when it is necessary to draw off the water which may collect from the condensation of steam in this place).

By this means the water in *x* will be vaporized, the vapor being drawn off as fast as it rises through the pipe *z'* into the condenser's cap *p*, and there condensed along with the exhaust steam from the engine, so that it serves to make up for the loss by leakage, &c., of the first supply. As the apparatus is of use only where the water for generating the steam is impure or salt, some mode is required for keeping the tank *x* clear of the deposit of these impurities, as by evaporation all these must collect in the evaporating vessel, according to laws well known. To remedy this, I connect the evaporating vessel with the box *h* by a pipe *z''*—said pipe entering the evaporator near its bottom, and discharging into box *h*, as shown. A cock or valve is also fitted into said pipe, to regulate the rate of discharge,

which takes place by gravity alone, as the two vessels are alike in vacuo. The saturated water will flow through the pipe z'' in the same manner as if x and h were both open vessels. If the supply for waste is to be made up from salt water, as in seagoing steamers, then a certain quantity of this water must be taken out of the tank by this pipe proportionate to the quantity evaporated, and thus the amount fed through the pipe z must be sufficient for both the evaporation and the quantity thus drawn off. The same rule applies to evaporating water containing lime or any other impurity. The water taken off through z'' enters the box h , and is pumped out with the condensing water by the air pump l .

In figure 5 is a view of a modification of a condensing apparatus—the same letters referring to the same parts, except where otherwise indicated. This is to show a mode whereby the radiating or surface condenser may be immersed in the condensing water, or showered at pleasure, and exhibits also a variation whereby the pump removing the water resulting from the condensed steam may be dispensed with.

In this case, when the pipes or other surfaces, n , are immersed in the water, they are subjected to the pressure of the same in a greater or less degree, according to its depth; but they are not subjected to the pressure of the atmosphere in addition, as will be shown. h' h'' represent two openings in h connecting the air pump l by the channel k . k' k'' are valves for closing the openings h' h'' , operated from the outside of the box h , as shown. If the pipes n are to be used submerged, the valve k'' must be closed, and valve k' opened. The condensing water being let on, fills up the box h until the water is on a line with the opening h' , and thus the pipes are immersed.

If the pipes are to be showered instead, then k'' must be opened, and the condensing water let on to the plate m , in the manner before described. When this plan is adopted, the aperture for insuring the equilibrium must be placed in such a situation that the condensing water cannot enter the pipes; in figure 5 it is shown at the pipe w' , and w'' is the stop or valve for opening or closing it. The next feature is a method of dispen-

sing with the pump u . A is a tank, air and water-tight, and capable of sustaining the pressure of the atmosphere. This is to be connected to t by a pipe, with a valve or cock intermediate, as t' . At t' is a delivery cock; at t'' is an air cock. The pump u being disconnected, t' is to be opened, and thus communication is made between the tank A and pipes n , as plainly shown— t'' and t''' being closed always when t' is opened. The water from the condensed steam will now descend by its gravity into A ; when A is full, t' must be closed— t'' and t''' opened, which permits the water in A to run out, being collected in reservoirs, from which the boilers are to be fed. As soon as A is empty, close t'' t''' , and open t' until again filled, and so on. The periodic opening and closing of these valves or cocks can be easily arranged to be operated by the works themselves.

Figure 4 exhibits another arrangement, embodying however the same general principles. The same letters are used to represent similar parts, described in the other figures. The principal variation in the construction of this part of my invention, consists in forming the box h , so that the tubes n shall be inserted in the two opposite sides, as shown in the dotted lines. In that case the caps p and r to cover them, are placed outside. The injection-cock o is placed at the bottom, and the delivery-pipe at the top, so that the pipes are shown as immersed in the water, but may be showered by making the changes before described. w''' represents a pipe forming a communication with the box h , and the interior of the pipes n , for keeping the pressure equal, and is equivalent to the aperture w , in figure 3, or w' in figure 5. Another variation consists in the manner of removing the water of the condensed steam, the same principle being applicable to removing the condensing water also. The pump u being taken off, a pipe a' is substituted which is attached to the cap r , where the water from the condensed steam accumulates. This pipe must have a descent vertically, sufficiently great to cause the column of water to counterbalance the atmospheric pressure (say of 34 feet), and may terminate in a reservoir. By this means the gravity of the water will overcome the vacuum in the pipes, and thus deliver itself without other mechanical aid.

I have thus set forth several modes in which I contemplate constructing, operating, and applying my invention, and I will now state wherein it differs from all others, and the advantages to be derived from the same.

First, by arranging the radiating or surface condenser, so that it is not subjected to the pressure of the atmosphere. Secondly: By reason of which arrangement, the apparatus is not so liable to be destroyed by the great pressure it would otherwise have to sustain; therefore durability and safety is increased. Thirdly: Small leaks and fractures will not affect its operation; the box *h* being exhausted of air or other uncondensable gases, which are not therefore present to flow through such apertures, and the condensing water will not enter, because there is no external pressure upon the pipes, to force it in; the water falling upon the pipes by gravity alone, its tendency will be to run out rather than in. Thus, where salt or other bad water is used for condensing, no admixture with the pure water of the condensed steam will take place. Fourthly: Increased safety; as the whole surface condenser might be destroyed in the box *h*, without impairing the working of the engine, or even arresting its motion. The only change perceivable would be the loss of fresh water, resulting from the condensed steam. This is a most important feature for seagoing steamers.

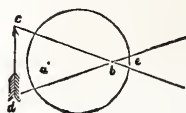
To the Editor of Appleton's Mechanics' Magazine.

SIR: I would desire to call your attention to the following experiment, and to the demonstration which I have founded on it:

Take an ox's or sheep's eye; remove the membranes which encircle the posterior part, to the extent of one-fourth or one-half inch; then clear away the nigrum pigmentum, and the expansion of the optic nerve, which yet cover the vitreous humor; now place an object, as a pen-knife, one-eighth or one-sixteenth of an inch in front of the cornea; then hold up the eye, with the knife in this position, and look through it as you would through an ordinary lens; and the knife will be seen in its upright position. I am not acquainted with any writer on physiology who has made any remarks on this fact, or who has even been aware

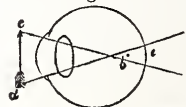
of it. All their reasoning on this subject has been founded on the assumption, that the focus* of the eye was within itself. Now, the following remarks are intended to controvert this opinion; first, by direct argument, founded on the above fact; second, indirect argument, by *reductio ad absurdum*; third, to explain why we cannot see objects erect through the ox eye at all distances; and fourth, to endeavor to account for the prevailing opinion.

Fig. 1.



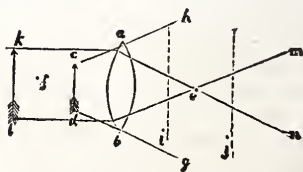
cross each other at *b*, and form an inverted image at *e*. This inversion will take place at whatever distance *c d* may be placed from the lens, whether near or remote; and let it be particularly noticed, that an erect image of *c d* cannot be obtained at *e*, for the rays have crossed before reaching that point.

Fig. 2.



Now, if the focus of an ox eye be within itself, as at *b*, fig. 2, and if the retina is beyond it, as at *e*, erect images cannot be seen in the rear of the eye, because, as we have already shown, the rays must cross each other at *b*; but it is a certain fact, that erect images of an object one-sixteenth of an inch distant from the cornea, can be seen in the rear of the eye, which demonstrates that the rays proceeding from *c d* have not yet crossed each other; and the fact of their passing through the eye without being inverted, proves that the focus is not at *b*, or at any point in front of the retina, *e*, between it and *c d*.

Fig. 3.



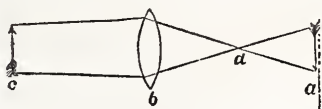
Let *a b* represent a lens whose foci are

* By focus I mean that point where the rays cross each other, where no image is visible.

e and *f*. Now, the rays of an object, *c d*, within the focus of *a b*, will be refracted in the direction *d g* and *c h*, and the object, *c d*, will be seen upright at *i* or *j*, or at any distance at which it is visible; rays passing from *k l*, beyond the focus, will be refracted by the lens in the direction of *k n* and *l m*, crossing at *e*. Hence *c d* and *k l* will be both seen upright at *i*, while at *j*, *c d* will be erect, and *k l* inverted. If the retina be beyond the focus at *j*, *c d* will be painted on it upright; and when removed to *k l*, the image will be inverted. So that Nature must have provided means for an upright image and an inverted one, to produce in the mind the same impression; or else, when an object is at *c d*, and the image upright, the optic nerve must convey the impression that it is upright; and when removed to *k l*, and the image is inverted, the optic nerve must still convey the impression that it is upright. How astonishing it is that, in the hurry of transposing these images, it never makes a blunder, and conveys one or the other of them wrong side up!

All these difficulties vanish, if I have succeeded in proving that the focus of the eye is not within its circumference, for the retina being at *i*, all objects, whether near or remote, are there painted erect only. There is no escape from the following dilemma: either the retina is at *i*, and all objects are painted on it erect, or it is at *j*, where near objects are erect and remote ones inverted, and then the mind and optic, separately or unitedly, possess the wonderful qualities here ascribed to them.

Fig. 4.



Let *a*, fig. 4, be a white wall in a dark room, *c* a candle, and *b* a lens, which gives an inverted image of *c* on *a* (such as a wall or sheet of white paper). Take some semi-opaque substance, as ground glass, wetted on the ground side to render it rather less opaque. Now, whether you hold this glass between the lens, *b*, and the focus, *d*, or between *d* and the wall, *a*, the image on the wall will be found in the same position as when there

was no opaque substance interposed; but a portion of the rays being intercepted, the image will be faint. Hence we see that rays of light, in passing through a semi-opaque substance, are not diverted from their course.

Modify the position of your lens *b*, and your object *c*, so that you can place your own eye in the position that *a* occupied in the previous experiment. When you have arranged it to the right focus, so that you see a clear inverted image of *c*, interpose your wetted glass between the focus and the lens, and on it will apparently be an inverted image of *c*, but we know that there is no inverted image at this point, because the rays have not crossed each other. These experiments prove that the appearance of inverted images on the retina is not conclusive proof that the focus of the eye is in front of the retina, for apparently an inverted image is seen on a semi-opaque substance on either side of the focus. I am well aware the apparent image on the retina is so clear and well defined that it is almost impossible to bring the mind to admit that it is an illusion.

The reasoning of physiologists to explain why we do not see objects inverted has always appeared to me unintelligible, and you can scarcely find any two writers who explain the process of erect vision in the same way; the arguments of each being unsatisfactory to every other one; their explanations satisfying none but themselves.

I think I have shown that the inverted image on the retina, which is the grand objection to my theory of erect images, falls to the ground before the experiment by which I can produce the same illusion with an ordinary lens and a piece of ground glass. Therefore I conclude that images of objects on the retina are erect, and not inverted.

Since the above was written, I have noticed an illusion on a large scale similar to the apparently inverted image on the retina. It may be seen in any druggist's shop window on their globes of colored water. The appearance on the surface of the globes of an inverted image of objects passing in the street, is as clear and well defined as in the instance of the ox eye, and yet we know that the rays have not crossed at the surface of the globes, therefore it is certain

there is no inverted image at that spot. This subject has been investigated by men of such undoubted ability, that I was unwilling to publish my opinion concerning it till my alleged fact, and my reasoning on the subject, had been investigated by men who, from their profession, ought to take an interest in such a matter; with this view, I have mentioned the subject to probably twelve or fifteen medical men, but I could not obtain a candid expression of opinion from a single one of them. I applied to a professor of physiology in one of the principal medical colleges in New-York; and he promised to examine my article on the subject, and give me a written answer, but he returned my manuscript without comment. His reason for forfeiting his word I do not know. I also applied to a celebrated lecturer on physiology, who happened to visit Newark, but with no better success. I laid my reasoning before a young doctor who had just finished his medical studies; he admitted he could not detect any flaw in my reasoning, but had not sufficient confidence in his own judgment to avow himself convinced. An oculist in New-York, who has written considerable on another speculative subject concerning the eye, had an engagement to attend as soon as I informed him I was not a professional man. At length my patience was exhausted by the absurdity of the plea, "that the subject had been investigated and decided," especially as there are numerous other matters which have been "decided and settled" wrong side up. So far from this dogmatical assumption of superior knowledge by medical men being well founded, I hesitate not to assert that they have not a philosophical knowledge of the ultimate cause of a single disease; and therefore, as matter of necessity, their remedies are all applied by guess, and it is notorious that every would-be wit considers the medical practice a legitimate subject for ridicule. We see external objects erect notwithstanding the doctors assert their images are inverted, and some sick men get well although the doctors pour various substances into their stomachs without knowing what will be their effect. The guessing practice of medicine is as absurd as the upside down theory of vision.

The body, like all other compounds, is composed of certain elements united in

various definite proportions; the excess or deficiency of any of these will produce disorder, and a correct system of medicine would be calculated to remedy the evils thus produced. Disease is the derangement of some part of the body by the presence of a substance not required, or by the absence of a substance which is indispensable to the integrity of some part.

I will only further remark that, whether the images of objects on the retina are inverted or not, it is most devoutly to be wished that the practice of medicine may become inverted, in the hope that the other side may be better than the one which is now uppermost.

NEWARK, N. J.

D.

COMPOUND RAILS FOR RAILROADS.

Mr. Latrobe, Engineer of the Baltimore and Ohio Railroad, in a paper recently published in the *American Railroad Journal*, has called the attention of Engineers to the evils attending the present imperfect modes of connecting the rails at the joints, and has proposed a remedy in the form of a rail composed of three parts. We refer to his paper, which will well repay a careful perusal, for a proper understanding of this rail.

A railroad as at present constructed, notwithstanding the apparent regularity of its surface, becomes, when passed over by a locomotive, a series of short waves, or undulations, whose summits are the centres of each separate rail, and the machine and the road receive immediately beyond each joint a shock, which must enhance the wear and tear of both, and sensibly interferes with the comfort of travelling on such roads, and with the feeling of safety at high speeds which the absence of the present rattle on the joints would leave undisturbed.

The evil has hitherto been of a nature not admitting of representation in money value, and hence Engineers have wisely deferred to bring it forward until the public was sufficiently familiar with railroad travelling to appreciate it.

We have no experience, as yet, on a large scale, of the absolute value of any of the arrangements of compound rails; but they are calculated, all but entirely, to perfect the track and to render the rail nearly equal to a continuous bar, from turnout to turnout, and such experiments

Fig. 1.



Fig. 2.

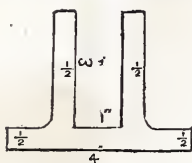


Fig. 3.

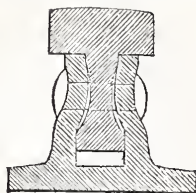


Fig. 4.



Fig. 5.

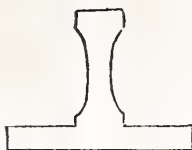


Fig. 6.

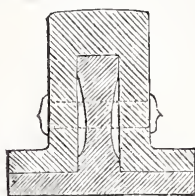
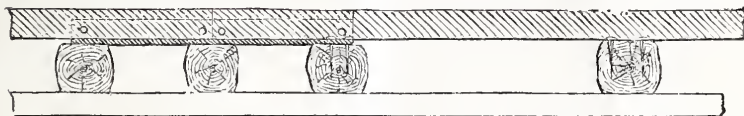


Fig. 7.



as have been made, though on a small scale, are eminently encouraging, and must lead to applications of the compound rail on a scale sufficient to test its fitness for the object in view, and its value in point of economy; and, to point out such corrections as the combinations first applied may require, we quote from Mr. Latrobe's paper:

"The existence of the evil of bad joints, and the difficulty of dealing with it, is amply demonstrated by the variety of expedients to *palliate* what is conceded to be *incurable*. Upon one line, for example, are to be found two cast iron chairs weighing together 45 lbs., applied to each bar—and upon another line, no chairs at all, but the rails simply let into the sleepers at the ends and spiked down. Upon other roads a chair weighing from 15 to 25 lbs., with a wooden key to hold fast the rail in it. Upon others again, chairs weighing from 12 to 20 lbs., with a lip on each side to lap tightly over the bottom flanges of the rail. On others a simple plate to support the ends of the bars and keep them sidewise in place, depending upon spikes to hold them down. On others the same plate with screw bolts in place of spikes; and lastly, upon one or two roads, two splice plates fitting on each side into the hollows of the rail and drawn tight by screw

or cotter bolts in a horizontal position. None of these modes of making the joints secure, operate as a splice, in effect, or but partially, at the first; for the violent blow given to the end of the bar by every passing wheel, soon jars loose the firmest grip that these fastenings can take. The wooden keys, besides their swelling and shrinking as the atmosphere changes, soon loosen, and the continual driving of them up rapidly wears them out. The spikes break, the screw bolts either snap off or have their thread stripped—and the keys of the cotter bolts become bent and broken from driving them up. The tight fitting clamp chair either breaks or wears loose in its lips. In short, no fastening that can be applied at this point holds its own long—and where, in despair of getting any contrivance to stand, all are rejected, and the rail is simply nailed down upon the sleeper, the latter is soon deeply indented and rapidly worn away by the bars it supports.

"It should be mentioned, while speaking of the difficulties of maintaining the joints of a track, that the endwise movement of the rail, under the blow of the wheel, is one of the most prominent. The bars are not all operated on alike by this cause, and consequently, some being pushed farther than others, the openings at the joints become irregular, some being closed entirely, and others widely open. This movement of the

rail is a very dangerous one, and unless watched, would soon force the rails quite out of their chairs, especially upon double lines of railway, where the movement of the trains, on each track, is always in the same direction.

"Instead of making the rails in solid or single bars, laid end to end, it is proposed to make them in parts combining to form the cross section of the rail—these parts breaking joint with each other, and held together by rivets, so as to form, in effect, a continuous bar of compound structure—being as near an approach to an unbroken line of iron as it is physically possible to make."

The following experiments, made by Mr. Latrobe, on the Baltimore and Ohio Railroad, possess much interest in connection with this subject:

"It is upwards of four years since, after several previous years' reflection upon the feasibility of constructing a track entirely of iron, without wood or stone supports, the form of compound rail of three parts, exhibited in the drawings hereto attached, suggested itself to me. I had, more than three years ago, an experimental piece of track, 200 feet in length, constructed of cast iron, and laid in the yard of the station at Mount Clare, in the environs of Baltimore. The cap rail, as well as the bearing rails, were of cast iron. The weight of cap was $17\frac{1}{2}$ and each bearing rail 42—total of the three $101\frac{1}{2}$ lbs. per yard. So were the cross ties of cast iron, and they weighed 37 lbs. each, and were 10 feet apart. The whole was held together by screw bolts, $\frac{1}{2}$ inch diameter, and two feet apart. The track was laid upon sand ballast, without any support of any kind. It has been ever since daily passed over by the heaviest trains that come at slow speed into the yard, and has received scarcely any attention in the way of adjustment. Yet it has held together perfectly, and although the cap rails, which were very light, and, like the bearing rails, cast in length of 20 feet long, have crumbled down at the edge, as cast iron always will under the tread of railway carriage wheels, but one or two of the bearing rails have broken and but one cross tie. The success of this track encouraged me to look to the general application of the principle in rolled iron, to rails of any weight over 50 lbs. per yard, and with or without supports of timber—as the size and weight of rail might make necessary. As I commenced with what I then considered the maximum of weight, about 100 lbs. per yard, in the rail, I made the next trial with the assumed maximum, (of 50 lbs. per yard,) and having an opportunity of getting the rail

rolled in the neighborhood of Baltimore, I had enough made to lay a section of 600 feet, and afterwards other sections of 200, 900, and 4500 feet, upon different points of the line. It was laid upon cross sleepers alone, placed about $2\frac{1}{2}$ feet from centre to centre, and $7\frac{1}{2}$ feet long, and 5×6 inches in section. The ballast, broken stone and gravel. A part of the first section was fastened by bolts, $\frac{1}{2}$ inch in diameter, the remainder was riveted. The bolts held very well, but required some occasional attention to make sure that they were tight. The rivets needed no such attention, and were, consequently, preferable. The cap rails were prevented from moving endwise by small key plates put through the neck of the rib, and with their ends fitting into notches, cut in the tops of the bearing rails. For the manner in which these experimental sections of track have worn, and how they have carried the trade and travel, for different times, during the last year and a half, I refer to the accompanying copies of certificates, signed by various officers of the Baltimore and Ohio Railroad Company. I need add nothing more than to say, that every additional month which goes by, only adds to the favor in which the new track is held by those who have charge of it, or travel over it. I am, therefore, enabled to appeal to that authority from which there is no further appeal—experience, and that acquired under circumstances so little favorable to the new track, that the argument is entirely *a fortiori*, when we reason about the results of future trials under more suitable conditions, for success.

It appears, as might have been expected, that the greater stability of the costly English Railroads, is in part due to their tracks resting on a greater bearing surface:

"In America, in tracks of 4 feet $8\frac{1}{2}$ inch gauge, laid on cross sleepers only—there are generally 6 sleepers of $7\frac{1}{2}$ feet long, by about 7 inches wide, allowed to every 15 feet. This gives $1\frac{1}{2}$ square feet of bearing surface per linear foot of track. The tracks laid with longitudinal timbers are few in number here; but their bearing surface per linear foot is from $1\frac{1}{2}$ to 2 square feet. In England larger provision is made for bearing surface, and it seems generally to range from $2\frac{1}{2}$ to 3 square feet per linear foot. The London and Northwestern, has 3 square feet per foot run. The Great Southern and Western of Ireland has $3\frac{1}{2}$ —the first is a 4 feet $8\frac{1}{2}$ inch gauge, the second 5 feet 3. The Great Western of England has $2\frac{1}{2}$ square feet per foot, and is of 7 feet gauge. The Midland Great Western of Ireland (of 5 feet 3 gauge) has

2 7-12 square feet per foot. The two first are laid only on cross sleepers—the third upon longitudinal, and the fourth upon a combination of the two.”

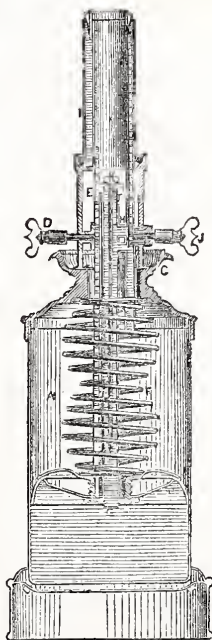
In connection with this subject, we will suggest another combination of compound rail—not as claiming for it, at present, greater merit than Mr. Latrobe's, for it has not been so thoroughly considered; but as a contribution to the discussion of this particular subject. The three-part rail appears, at first sight, to be unnecessarily complicated, although it may turn out that this complication is more apparent than real, and that it secures advantages which more than compensate for the multiplicity of parts. The accompanying figures, 1, 2, and 3, will explain the two-part rail alluded to. It contemplates the use of ties as now. The lips of the lower rail are compressed by a suitable instrument so as to secure firmly the upper rail, either throughout its whole extent, or at those points only where the rivets are inserted. A slight permanent bending of these lips, it is conceived, will effectually secure the upper rail in its place—nor would the separation of these, when necessary, in the course of repairs of track, be a difficult operation.

Until some form of compound rail has received that general approval which must precede its introduction on new roads, a long wrought-iron chair can be applied to the bridge rail, so as to reduce considerably the evil of loose joints, and render the strength of the track at these joints more nearly uniform with the rest of the track than hitherto. Figures 4, 5, 6, and 7, will explain the nature of the chair suggested. A chair nearly similar to this, but of cast iron, is being used, or is proposed to be used, on one of the Virginia roads.

Our notice of this subject would be incomplete without allusion to the compound rail of Mr. A. B. Seymour, which consists, we believe, of but two parts, divided vertically and connected by rivets or bolts. It appears that a portion of this rail (1000 feet) has been laid on the Utica and Schenectady Railroad, and has borne the test of two years' travel. The testimony of Mr. Vibbard, the Superintendent of that railroad, is very favorable to its action, as compared with the common H rail. A short piece of track on the New-York and Erie Railroad is laid with this rail, and we can bear testimony

to the smoothness with which the trains pass over it. But it would be premature to say, of any form of compound rail at present on trial, that it will fulfil, satisfactorily, the objects sought. The probability is, rather, that the most efficient form is yet to be ascertained. May we hope that those now in the field, who have devoted time and thought to the subject, will maintain their judgments, sufficiently unbiassed, to take advantage of any improvements in their plans which experience may suggest, that they may receive, by and by, that credit, and profit too, which their labors deserve. C.

HADROT'S MODERATOR LAMP.



The reign of gas has not quite brought about the extinguishing of our old principle of portable lights, if we are to take the number and variety of modern oil and candle lamps as any thing of a criterion. There are, it appears, still many uses for the oil lamp, and quite enough to stimulate invention for its improvement. In France, where the introduction of gas has

been more slowly developed than with us, a great amount of talent has been expended, even in late years, both upon the working mechanism and the ornamental design of lamps. Of these, the *Carcel*, a curious compound of clockwork and pumps, has been very extensively used; but in the search after simplicity, and consequent cheapness of execution, this complicated plan is being gradually superseded by applications of direct spring pressure. Such a contrivance is "Hadrot's Moderator."

Our engraving represents a vertical section of the mechanical details of the simplest form of this lamp, as denuded of all ornament. The base of the pedestal contains the oil cylinder, A, entirely closed at the bottom, and fitted with a piston, B, made with a cup-leather packing, somewhat like the packing of a hydrostatic press. The oil is supplied to the cylindrical reservoir in the usual way, by pouring it into the cup, C, whence it runs down into the cylinder on the top of the piston. The piston then being elevated by turning the little handle, D, the spindle of which carries a pinion gearing with a rack, E, fast to the piston; the vacuum beneath the piston causes the oil to pass the sides of the packing, and take up its position beneath, as in the engraving. The elevating power for the oil is obtained from the helical spring, F, formed in four cones, for the purpose of compressing into a small depth. Its upper end abuts against the top of the cylinder, whilst its opposite extremity rests on the piston. When put in action, the piston is wound up to the top of the cylinder, and the downward pressure thus obtained by the reaction of the spring, forces the oil up the tubular piston-rod, G. The upper open end of the piston-rod, G, enters into the lower open end of a similar fixed tube, fitting accurately to it, so that the oil, in passing upwards, enters this second tube. Two small side openings at H, conduct it thence to the ordinary annular recess, I, of the wick. The regulator for the height of the wick is at J; its spindle carries a pinion, gearing with a vertical rack in the usual manner. It is, however, in the mode adopted for the adjustment of the oil supply to the burner, at all or any state of the spring pressure, that the improvement for which the inventor claims the name, "Modera-

tor" consists. The top of the upper tube, over the tubular piston-rod is closed in by a screw-cap, through which is entered a long spindle, K, of small diameter. This spindle passes directly down the centre of the rod, and whilst it permits of a free flow of oil through the tube, its presence, by producing frictional resistance, tends to retard the flow, or restrict it within certain limits. By this contrivance, the higher the piston is elevated, the further does the fixed regulating rod, K, penetrate into the tubular rod, G; and thus is provided a greater frictional resistance to the flow, just as the greater compression of the spring, F, tends to force the fluid up more strongly.

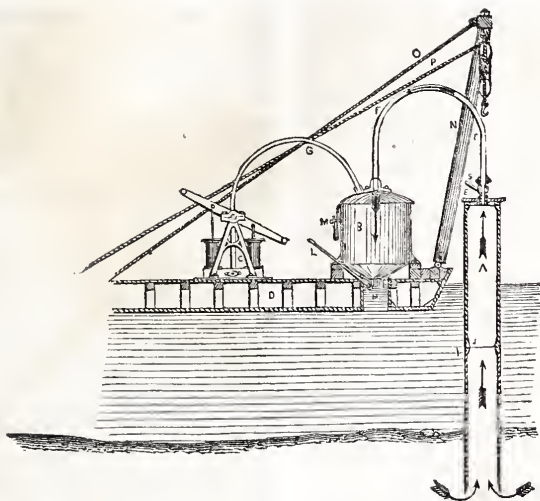
The "Moderator" appears to answer extremely well in preventing an undue overflow at the burner, whilst its simplicity leaves little chance for derangement. —*Glasgow Practical Mechanic.*

PNEUMATIC PILE-DRIVING.

The extensive use which has been made of hollow piles in England, within a few years, and the uniform success attending their operation, have excited considerable attention in this country.

Several of our most distinguished engineers, military and civil, have investigated the subject, with the view to their adoption; and it is believed, in every instance, an opinion has been formed that in some positions their use will afford the only certain means of securing permanent foundations, and that great economy, with absolute security, will result from their substitution, in very many cases, for the methods ordinarily adopted to accomplish these purposes. This has been demonstrated practically in England by the experience of eminent engineers, who adopted this system of foundation for beacons and bridges, and by the sinking of a hollow pile to the depth of 78 feet in the Godwin Sands.

These sands, which change their position with every violent storm, are so compact that a steel bar could be driven only 8 feet by a sledge hammer; and a pointed rod, 3 inches in diameter, when sunk 13 feet deep in the sand, required forty-six blows of a monkey weighing 1 cwt., with 10 feet fall, to drive it *one inch* deeper; yet subsequently a hollow pile,

*Sketch.*

2 1-2 feet in diameter, was sunk in these sands, by the pneumatic principle, to the depth of 78 feet, at the rate, for a portion of the time, of 10 feet per hour.

There are few positions where hollow piles may not be used with highly economical results, in lieu of coffer dams, to obtain secure and durable foundations. Frank Foster, C. E., acting with Robert Stephenson in the construction of the Britannia Bridge, adopted this system of foundation for a pier in a tidal river in Anglesey, where the wash was very great, owing to the force of the current and the movable nature of the sand. Two years after the pier had been completed, he wrote a letter to the inventor, from which the following is extracted: "The piles that were placed by your patent process under one of the piers in a tidal river in Anglesey, appear in every respect to answer perfectly well. The weight upon them is very great, and the piles are from two to three feet out of the water, so as to allow free water way between them and under the piers." The piles alluded to are 1 foot in diameter and 16 feet in length; they are nineteen in number, and they sustain a weight of 600 tons.

The sketch below will serve to illustrate the general principle of sinking hollow piles, as well as the particular manner of sinking them, for the support of a pier, described by Mr. Foster.

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D, the boat anchored properly; A, the pile, cast in lengths of 10 feet, connected at the scarf joint, I, by tap bolts; N, shears used in hoisting the pile; C, air pump; B, receiver; E, movable top for the pile, through which passes the gutta tube, F, leading to the receiver.

The operation is conducted by first exhausting the receiver, B, by means of the air pump, C; the pile, A, being connected to the receiver by the tube, E, but communication with it cut off by closing the cock, S. The pile is raised by the shears, suspended over the place where it is to be sunk, and then lowered until it rests on the bed of the river. Immediately thereafter the cock, S, is opened, and as a consequence, the air within the pile rushes into the receiver, the external pressure of atmosphere, water and sand, produce a current in the direction of the arrows, while the weight of the pile and atmospheric pressure on top, operating at the same instant, cause it to descend rapidly, in a manner precisely similar to the effect of a blow. The contents of the receiver are then discharged through the valve, H, and the operation is repeated.

Where the material through which the pile is to be driven contains coarse gravel or stones of large size, it has been found most advisable to adopt the process above described; but in quick-sand,

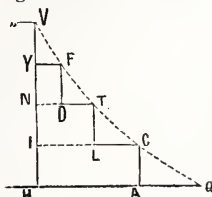
or ordinary beach, or shoal sands, it would be quite as well to exhaust the air from the pile, without previously closing the cock, *s.* In this process, the pile settles gradually, corresponding to the capacity of the air pump and rapidity with which it is operated.

(To be continued.)

MECHANICS FOR THE MILLION.—NO 3.

WORK IN MOVING A BODY ON AN INCLINE PLANE.

10. If a body be moved along any surface, without friction, the work performed is equal to the product of the weight of the body in lbs. by the vertical height in feet through which it is raised.



Let a body be moved slowly along the line $A C L T D F Y V$, then the work done will be that which is due to the perpendicular height, $H V$, through which the body is raised: because the work done through the vertical line, $A C$, is the same as that which would be done through $H I$; now, because $C I$ is a horizontal line, and since there is no friction, it will not require any work to move the body from C to L ; in like manner the work done through the vertical line, $L T$, will be that which is due to the perpendicular height, $I N$, and the work done on the horizontal line, $T D$ will be nothing; and so on; so that the whole work upon the body is simply that which would be performed in raising it through the vertical line, $H V$.

Now, since the parts $A C, C L, L T, T D, D F$, &c., may be taken of any relative dimensions, or they may be taken as small as we please; therefore the line $A C L T D F Y V$ may be made to coincide with any assignable figure, or at least to approximate to the form of any curve nearer than any assignable difference.

11. Work in overcoming the resistances of friction and gravity.

If the inclination of a plane, upon which a body is moved, is small, the pressure upon the plane will obviously be very

nearly equal to the weight of the body; hence the work of friction will be calculated after the manner explained in Art. 7, and that of gravity by Art. 10.

Ex. 1. A train of 80 tons ascends an incline which has a rise of 2 feet in every 100 feet, with the uniform speed of 15 miles per hour, what must be the effective horse powers of the engine, the friction being as usual?

Speed train per min. = 1320 ft.

Weight train in lbs. = 179200.

Rise of the rail for 1 ft. = $\frac{2}{100}$ ft.

$\therefore$ " 1320 ft. = $\frac{2}{100} \times 1320$
= 26.4 ft.

Hence it appears that the whole weight of the train is raised 26.4 ft. every minute in opposition to gravity.

$\therefore$ Work due to gravity per min. = $179200 \times 26.4 = 4730880$.

But work due to friction per min. = $8 \times 80 \times 1320 = 844800$.

$\therefore$ Total work per min. = $4730880 + 844800 = 5575680$.

And H. P. = $\frac{5575680}{33000} = 168.9$.

Ex. 2. A train of 100 tons ascends an incline which has a rise of $\frac{1}{8}$ in 100; required the maximum speed when the effective horse-powers of the engine = 80.

Let x = the speed of the train in feet per hour.

Rise rail in 1 ft. = $\frac{1}{8} \div 100 = \frac{1}{800}$ ft.

" " x ft. = $\frac{x}{600}$ ft.

$\therefore$ Work due to gravity = $100 \times 2240 \times \frac{x}{600}$

$\therefore$ Work due to friction = $100 \times 8 \times x$.

Now the work due to gravity per hour, added to the work due to friction per hour, must be equal to the work done by the engine in the same time.

$\therefore 100 \times 2240 \times \frac{x}{600} + 100 \times 8 \times x = 80 \times 33000 \times 60$.

$\therefore x = 135000$ ft. = 25.5 miles.

Ex. 3. A train of 100 tons descends a gradient having a rise of $\frac{1}{4}$ in 100, with a steady speed of 60 miles per hour; it is required to know the H. P. of the engine.

Here, work due to friction per min. = 4224000.

Work due to gravity per min. = $224000 \times 13.2 = 2956800$.

In this example gravity acts with the engine.

∴ Work engine per min. = 4224000 — 2956800 = 1267200.

And H. P. = 38.4.

If a horse exert a traction of 160 lbs., what weight will he pull up a hill which has a rise of 3 ft. in 100 ft., supposing the co-efficient of friction to be $\frac{1}{12}$?

Work of the horse in moving over 100 ft. = 160×100 .

Work of friction in moving 1 lb. over 100 ft. = $\frac{1}{12} \times 100$.

Work of gravity in same = 1×3 .

Total work in moving 1 lb. over 100 ft. = $\frac{100}{12} + 3 = 11.3$.

∴ No. lbs drawn = $\frac{160 \times 100}{11.3}$ lbs. =

12.6 cwt.

Ex. 4. How many horses would it take to draw a load of 6 tons up a hill, having a rise of $2\frac{1}{2}$ in 100, supposing the resistance of friction to be $\frac{1}{12}$ of the whole load, and the traction of each horse 160 pounds?

Work due to friction in moving 6 tons over 100 ft. = 1170.

Work due to gravity in same = 336.

Total work in moving 6 tons over 100 ft. = 1456.

Work of 1 horse in 100 ft. = 160.

∴ No. of horses = $\frac{\text{Total work}}{\text{Work of 1 horse}} =$

9.1.

Ex. 5. What work will a horse perform in transporting a load of 1 ton, on the road in the last example, to the distance of 10 miles, when the total rise is 50 feet?

Work due to friction = $\frac{2240}{12} \times 10 \times 5280$.

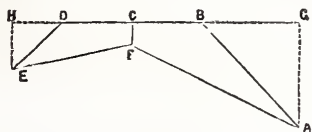
Work due to gravity = 2240×50 .

∴ Total work = 9968000.

LAWRENCEBURG, INDIANA, March 3d. 1851.

MR. EDITOR,—The following method of arriving at the equivalent cut or fill of an irregular cross section, without first finding the area, was originated by me last summer, during the time that I was engaged in calculating the cubic yards on the first division of this line; I am not aware of its ever having been investigated by any other engineer. You will notice that by combining it with Prof. Gillespie's method of calculating

cubic quantities, when the equivalent cut or fill is given, it forms a method, not only mathematically correct, but more expeditious in practice than any hitherto given. Should you consider it worthy of a place in your excellent periodical, the "Mechanics' Magazine and Engineers' Journal," you are at liberty to insert it. The following Algebraic investigation will show the process by which I arrived at the formula.



Let A B C D E F A represent an irregular cross section, in which B D = w = width of road-bed at grade; c F = centre cut or fill = h ; c G = right side distance = n ; c H = left side distance = m ; also let s = ratio of side slope to unity. Then we have

$$A G = (n - \frac{w}{2}) \times \frac{1}{s} = \frac{2n - w}{2s} =$$

altitude of triangle A B C; and

$$E H = (m - \frac{w}{2}) \times \frac{1}{s} = \frac{2m - w}{2s} =$$

altitude of E D C.

Then area A B C =

$$\frac{2n - w}{2s} \times \frac{w}{2} \div 2 = \frac{2nw - w^2}{8s}$$

Area E D C =

$$\frac{2m - w}{2s} \times \frac{w}{2} \div 2 = \frac{2mw - w^2}{8s}$$

$$\text{Area A F C} = \frac{nh}{2}$$

$$\text{Area E F C} = \frac{mh}{2}$$

hence area of entire cross section =

$$\frac{2nw - w^2}{8s} + \frac{2mw - w^2}{8s} + \frac{nh}{2} + \frac{mh}{2}$$

$$= \text{by reducing and separating into factors} \\ \frac{(n + m)(w + 2sh) - w^2}{4s} \dots (1)$$

Now let the trapezoid A B C D A represent the regular cross sections equivalent to the given irregular cross section, and having the same base and side slope de-



note the area as found above by a , and the required equivalent cut or fill by x . Then the line $AD = w + 2sx$, and by the rule for finding the area of a trapezoid we have $(w + sx)x = a$, or $sx^2 + wx = a$. By solving this equation we have

$$x = \sqrt{\left(\frac{a}{s} + \frac{w^2}{4s^2}\right)} - \frac{w}{2s} \dots (2),$$

and by substituting for a in equation (2) its value in equation (1), we have

$$x = \sqrt{\frac{(n+m)(w+2sh) - w^2 + w^2}{4s^2}} - \frac{w}{2s}$$

By reduction—

$$x = \sqrt{\frac{(n+m)(w+2sh)}{4s^2}} - \frac{w}{2s}$$

which is the general formula.

When $s = 1\frac{1}{2}$, the above formula gives

$$x = \sqrt{\frac{(n+m)(w+3h)}{9}} - \frac{w}{3}$$

When $s = 1$,

$$x = \sqrt{\frac{(n+m)(w+2h)}{4}} - \frac{w}{2}$$

When $s = \frac{1}{2}$, the formula becomes

$$x = \sqrt{(n+m)(w+h)} - w$$

Rule derived from the above formula:

—When the slope is $1\frac{1}{2}$ to 1, multiply the centre cut, or fill by three; to the product add the width of road-bed at grade, multiply this sum by the sum of the side distances, divide the product by nine, extract the square root of the quotient, and from the square root subtract one-third of the base of road at grade, the remainder is the equivalent cut or fill required. This rule, slightly modified, as indicated by the formulas, applies to any slope whatever.

Example first.—Let base of road, or $w = 16$ feet, n and $m = 20$ and 29 ; slope $1\frac{1}{2}$ to 1; centre cut or fill = 8 feet. Then

$$x = \sqrt{\frac{49(16+24)}{9}} - \frac{16}{3} = 9.4$$

Example second.—Base and slope the

same; centre cut, or fill, = 20 feet; side distances = 28 and 40. Then

$$x = \sqrt{\frac{68(16+60)}{9}} - \frac{16}{3} = 18.6$$

Professor Gillespie's formula for cubic quantities is

$$[(g+h)^2 + b(g+h) - gh] \frac{l}{2}$$

in which b = width of road-bed at grade, s = ratio of side slope to unity, g and h = the equivalent cuts or fills, which he finds by means of areas; and l = lengths of stations or distance between cross-sections. When $s = 1\frac{1}{2}$ to 1, the above formula, as shown by Mr. Gillespie, becomes

$$[(b+g+h)(g+h) - gh] \frac{l}{2}$$

Now, if in the last formula we suppose l = feet, and in place of b , g , and h , we substitute their values in the above examples, we have

$$[(16+9.4+18.6)(9.4+18.6) - 9.4 \times 18.6] \times \frac{100}{2} \div 27 = 1957.7 \text{ yards.}$$

Respectfully yours,

WILLIAM ROCK,

Assistant Civil Engineer, Lawrenceburg
and Upper Mississippi Railroad.

NOTE.—The above formulæ are founded on the supposition that the surface of the ground is a plane from the centre to the slope stakes; and as this is the case in nine-tenths of the examples that occur in practice, the formulæ are quite general in their application.—W. R.

[We shall be pleased to hear from Mr. Rock at his convenience on any branch of his profession; but if he will select some other letters than n w and m to bring together in the same formula, it will save us the trouble of *working them out* at the proof-readings.]

The formula is, we believe, new, and, for a general one, is the simplest we have ever seen.]

COMBUSTION OF COAL APPLIED TO THE
PURPOSES OF STEAM NAVIGATION.

BY CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.

There appears to be among the mass of practical steam engineers, though men

of experience and abilities in the manipulations of their machinery, a want of knowledge as to the *rationale* of the effects they are constantly producing; and in no department of their profession does this want appear so great as in that relating to the combustion of their fuel; yet this is one of the most important departments of steam engineering, for on it depends the grand problem of the future progress of steam navigation, viz., how to save coal.

This knowledge is to be found distributed among the writings of the modern chemists, but they are too voluminous and often too inaccessible for study to men engaged in daily labor, besides being frequently mixed with other subjects in a manner requiring considerable discrimination to recognize and separate them. I have therefore thought it would be acceptable to the practical steam engineer to present a condensed view of the more important facts and hypotheses, in language as destitute as desirable of technical expressions. Without a knowledge of the laws which govern combustion, and a clear generalization of observed facts, it is evident there must be great waste by ignorance, both in the use of the fuel itself, and in the proportioning of the boiler where its effects are to be developed. I have therefore added a very condensed summary of the very voluminous experiments and report made in 1842 and 1843, by Prof. Walter R. Johnson, by order of the United States government. This report has never reached the hands of the practical world; and from the minuteness and copiousness with which every experiment is detailed, and the great number of experiments made, together with a want of condensed generalization of those results only which would be of use in the common engineering practice, it would perhaps be but of little value to the great majority. Presented in the present form, however, I am persuaded these valuable experiments will not be lost on steam engineers. I further propose to follow the present paper with some remarks on the proper proportioning of boilers.

COMBUSTION.

Combustion is the term applied to those chemical unions which, taking place at certain temperatures, produce the phenomena of light and heat. These phe-

nomena are not developed by all chemical combinations.

According to the theory of the latest British and French chemists, combustion—and ignition, which is the effect of it—is thus explained: “*That in all chemical combinations there is a neutralization of opposite electricities, and that that neutralization produces fire.*”—BERZELIUS, vol. 1, p. 212.

Again, Berzelius considering fire as an electrical phenomenon, says: “*It (the phenomenon of fire) takes place just at the moment the bodies combine, their opposite electrical states reciprocally neutralizing them, a circumstance in which fire is produced in the same manner as it is manifested in the discharge of a Leyden battery or thunderbolt.*”

Thus it appears that the prevailing opinion among the highest British and continental authorities is, that chemical action producing light and heat is identical with electrical agency, and caused by the forming of an equilibrium between bodies in opposite electrical states, as when electricity passes from one body or person to another.

From the foregoing, it will be perceived that combustion being those chemical combinations, which, at certain temperatures, produce the phenomena of light and heat, the common language of describing one body as “*combustible*,” and another as a “*supporter of combustion*,” is wholly erroneous and unfounded in truth. All that is known of the matter is, that some chemical unions of bodies at certain temperatures produce a new class of bodies, and in that production evolve light and heat. There are some bodies, which, possessing universally strong affinities for all other bodies, form with them at certain temperatures those chemical unions to which the term combustion is applied. These are oxygen, hydrogen, bromine, iodine, and chlorine, all simple or elementary bodies. They have been called (especially oxygen), in loose language, “*supporters of combustion*,” and the bodies with which they combine, “*combustible*.” This is erroneous, and misleads the inquirer by using positive language when nothing is known with certainty. For instance, there is no more reason for asserting that, in the chemical union of carbon and oxygen, the carbon to be “*combustible*,” and the oxygen a

"*supporter of combustion*," than the oxygen to be "*combustible*" and the carbon "*a supporter of combustion*." All that is really known is, that the chemical combination of these substances at certain temperatures causes the phenomena of combustion.

Chemical combination takes place with some bodies when presented to each other at ordinary temperatures, while other bodies require temperatures considerably elevated. In general, however, chemical combination, to be attended with the phenomena of combustion, must take place at temperatures not less than a red heat, and the higher the temperature, as a general result (within the range of which we have knowledge), the more rapid the combination, and the more vivid and intense the combustion. To this however there are exceptions. The metal potassium, at ordinary temperatures, thrown upon ice, exhibits all the phenomena of intense combustion, the metal absorbing oxygen from the ice with great avidity, and liberating the hydrogen; the results being oxide of potassium or potassa and free hydrogen; these changes being attended with evolution of heat. On the contrary, an explosive mixture of carburetted hydrogen gas and atmospheric air, according to Sir Humphrey Davy's experiments, could not be fired with an iron rod at the highest degree of red heat, nor at the common degree of white heat, but required a flame to be applied before explosion took place.

It may be inferred, that, although the presence of caloric is necessary for the chemical union of bodies, yet, that under extremes of temperature, high and low, no bodies would chemically unite. Between these extremes, chemical combination takes place at every intermediate degree, according to the strength of affinity that bodies have for each other. The influence of temperature upon chemical combinations generally, may thus be explained. The results of chemical combinations (to which, in common language, the term "*products of combustion*" has been applied, when derived from those chemical unions called combustion) are consequently compound bodies. It is known from experiment, that chemical affinity only acts within certain insensible distances, this contiguity of

atoms being necessary for its action. The result of this restriction of the action of chemical affinity within these insensible distances, is, that when, by the interposition of the matter of caloric between the ultimate particles of bodies, these particles are separated and placed at distances apart beyond the sphere or range of chemical affinity, it is impossible for them to unite, and of course combustion, that is, chemical combination, is prevented. Suppose all the elementary atoms of bodies, under the influence of this high temperature, to be presented to each other, no chemical combination or combustion ensuing, because the atoms are kept by the matter of caloric at distances apart beyond the range of chemical affinity; and then let the temperature be lowered gradually; at each gradation, some of these atoms would combine, and others remain uncombined; some of these again, at other gradations, would combine, and some would remain uncombined until still lower gradations were reached; and in this manner we may conceive certain degrees of temperature necessary to certain combinations, each combination having its peculiar degree of temperature lying at some point within the extremes of high and low. This may be illustrated by the state in which we find oxygen and hydrogen gases at ordinary temperatures, intimately mixed yet uncombined, notwithstanding their great affinity. Mercury and oxygen also furnish another illustration. At 350°C they combine, forming a red crystalline powder, oxide of mercury; and at 400°C this powder is again resolved into oxygen gas and mercurial vapor.

On the other hand, numerous observations have proved that reduction of temperature retards or prevents chemical combination as a general result; and upon the theory that *certain* temperatures are necessary to give effect to chemical affinity, it is obvious there may exist a temperature too low as well as too high for the action of this principle. This may be accounted for upon the supposition, that by reduction of temperature the quantity of the matter of caloric between the atoms of bodies being diminished, they approach each other by their homogeneous attraction; the force of that attraction increasing as the square of the distance decreases, it may, when

the atoms are within a certain contiguity, exceed the force of chemical attraction, and thus prevent chemical combination. Chemical affinity being stronger between some atoms than others, would act at a relatively greater distance, and thus cause chemical combination at a relatively higher temperature. Again, homogeneous attraction being stronger between some atoms than others, would act at a relatively greater distance, thus causing the necessity for a higher temperature in order to remove the atoms beyond the sphere of that attraction before chemical combination could take place. It will thus be perceived, that chemical affinity and homogeneous attraction are controlled in their action by the presence of caloric; a certain proportion of caloric being required to be present for the action of chemical affinity, and if present, in a greater or less proportion preventing this action by removing, if in excess, the atoms beyond its sphere, and if too little, by insufficiently weakening the homogeneous attraction.

(To be continued.)

MISCELLANEOUS.

PAINE'S LIGHT.—EXPERIMENTAL INVESTIGATION OF THE EFFECT OF PASSING HYDROGEN GAS THROUGH TURPENTINE.

We take the following from the London Mechanics' Magazine, as tending to confirm our own view of the value of Mr. Paine's patent.

Sir,—I am much astonished to see, as I do in your 1434th Number, such an extraordinary matter made of a simple experiment. Many surmises and hypotheses are propounded which are dependent upon an assumed fact, that turpentine loses nothing in weight when hydrogen has been passed through it, yet that the so transmitted hydrogen gives a greatly increased light. Now I must place myself in the same position as the philosopher did when King Charles proposed his question about the fish in a pail of water—I must deny the fact.

Hydrogen, passed through spirits of turpentine, *does* dissolve a portion; and to this turpentine the light is entirely owing. In my laboratory an accurate ex-

periment has been made, in which $5\frac{1}{2}$ ozs. of zinc were dissolved, and 2.38 cubic feet of hydrogen disengaged; these were passed through spirits of turpentine—as the temperature increased, the hydrogen flame became bright, and at the close it was found that 33 grains of the fluid had been absorbed. I presume, therefore, that Mr. Paine, when exposing his process, could not have resorted to the balance as a test of the truth of what he advanced. I hope there is better ground for the claim of wonderful improvement in the decomposition of water, otherwise Mr. Paine will be a long time before he pays the expenses of his patent out of profits.—H.

[The preceding communication is from an English chemist of the first celebrity as an experimental investigator.—Ed. M. M.]

WATER GAS.—SHEPARD'S PATENT.

(From the "Freeman's Journal.")

Our readers are familiar with the fact that an American (Paine) had succeeded in decomposing water, and so combining its hydrogen with carbon as to form an illuminating gas, which he proposed as a substitute for the gas produced by the destructive distillation of coal in iron retorts. The invention at first attracted a great deal of attention; but so far as we have been able to learn, the process by which the gas was produced was both *costly* and *uncertain*. Since the period at which the American discovery was announced, a German chemist of great eminence has announced the discovery of a process by which the water may be decomposed, and the carburetted hydrogen formed at little more than a nominal cost, with unerring certainty, and in practically an unlimited quantity. The gas so produced is said to possess illuminating power far exceeding that of ordinary coal gas, and is capable of producing, in the act of combustion, such an amount of caloric as to constitute an economic substitute for coal in the generation of water steam for the propulsion of boats and locomotives.

This invention has been patented in most of the countries of the European continent—in England, in Scotland, and in Ireland, by Mr. Shepard, an English gentleman, whose intimate connection

with the continental states afforded him peculiar facilities for the great enterprise in which he has embarked. We understand that the gas produced by Mr. Shepard's patent is not only capable of being used as a fuel for the generation of steam, but is itself capable of being adapted to all the uses to which steam power is now applied—the expansive gas itself performing the functions of high-pressure steam. Several great English Companies have already entered into contracts for the use of this patent, which if it should realize the expectations of the patentee is destined to create a revolution little inferior to that created by the application of steam as a locomotive power. The great value of the patent is said to be the low cost at which the gas can be produced.

The Times thus alludes to this strange and most interesting invention:

One or two of the principal railway companies have lately entered into an arrangement with Mr. Shepard, who has patented an invention for the decomposition of water, and negotiations are pending with some steamboat and gas companies for the application of this patent to propel steamboats, locomotives, and other engines, by which the cost of working machinery and generating gas is likely to be greatly reduced. At the coming Exhibition we hope to have an opportunity of testing the merits of this wonderful invention."

PHOTOGRAPHY ON GLASS.

We have had before us some results of a new process by which photographic negatives are taken on glass—to be afterwards transferred to paper, by means of a lens, on an increased scale,—that transcend every thing of the kind which the art has yet produced. The discovery was met with in Paris by Mr. Mayall, who brought it over to this country,—and sets his face against all patenting of secrets which tend to the advancement of Art. The specimens which we have seen are intended for the Palace of Glass; but in the mean time Mr. Mayall proposes to publish in our columns, for the benefit of all practitioners; the particulars of a process which carries the art of spontaneous translation to a point on

which it is difficult to imagine an advance.

The value of this process is enhanced by the capacity to enlarge, by the application of a magnifying power, the dimensions of the image produced on the negative plate. In this way, without creating to the traveller the embarrassment of extra luggage, he may make his negatives on as small a scale as may be convenient,—reserving to himself the choice of producing at a future time positives of such dimensions as he may desire. For topography and for the transcription of the peculiarities and minute details of architecture and costume, this discovery will prove of great value.

There are in the impressions resulting from this process a clearness and a sharpness of definition in the architectural subjects such as we have never before seen. Some calotypes from the hands of Mr. Thomas Elmore, that we have examined privately, made the nearest approach to the excellence here reached. The impressions that we have looked at are, as we have said, wonderful for their perspicuity and truth. In a view of the portico of the Madeleine, as seen from the Rue Royale, the details of the tympanum, the frieze, the capitals, the bases, the shafts, the inscriptions, and the bas-reliefs, seen through a magnifying glass at our side, are extraordinary. The rendering of the bas-relief in the pediment is most perfect. Two views of the Salle de la Convention are marvellous to the naked eye:—through the lens they reveal details which will provoke the admiration of the architect. When the process shall be devoted to high examples of Greek practice, we doubt not that it may be made to record with unfailling truth subjects hitherto imperfectly known. The Porte St. Denis is another example of wonderful truth-telling;—even to the minutæ of the inscription, "Liberté, Égalité, Fraternité." The view of the Arsenal is, as Dominic Sampson would say, "Prodigious!" Never was seen such perfection of detail. The subject is striking and novel. The foreground composed of the rectilinearly arranged masses of shot, the gun carriages, and the men actively engaged in their duties, were just the objects to test the fidelity of this highly sensitive medium. The artist may throw down his brush in

despair. No human eye or hand could trace from the objects themselves within any moderate degree of accuracy such details.

The following is the process by which the negatives on glass were taken—as furnished to us by Mr. Mayall.

First, the albumen of a *fresh* egg must be beaten into a snow-like mass with a bunch of quills, dropping into it ten drops of a saturated solution of iodide of potassium; allow it to stand six hours in a place free from dust, and moderately warm, say 60°.

Second, a piece of hand-plate glass eight inches by six, with the edges ground smooth, must be cleaned as follows; with a piece of cotton-wool rub over both sides with concentrated nitric acid, then rinse well with water and dry.

Stick a wafer on that side, which I will now call the back, to mark it; pounce upon the face a moderate quantity of fine tripoli, moistened with a few drops of a concentrated solution of carbonate of potash, then with a piece of cotton-wool rub the surface briskly in circles for about five minutes; then with dry tripoli; then with clean cotton, to clear away all the dusty particles.

Third, to the centre of the back stick a gutta-percha ball, as a handle; strain the prepared albumen through clean linen, pour it gently into the centre of the cleaned side of the glass, keep it moving until the surface is entirely covered, run it into the corners, and finally pour off any excess at the four corners; disengage the gutta-percha handle, and place the glass on another slab of glass that has been levelled by a *spirit level*, in a place perfectly free from dust and moderately warm; I will call this my *iodo-albumenized glass*; it will keep for any length of time, and may be prepared in daylight.

Fourth, to *excite*, a yellow shaded light only being used, dissolve 50 grains of nitrate of silver in 1 ounce of distilled water, and 120 grains of strong acetic acid; pour the whole of this solution into a *cuvette*, or shallow porcelain dish, a little larger than the glass plate; place one end of the iodo-albumenized glass into the solution; with a piece of quill support the upper end of the glass, and let it fall suddenly on to the solution, lifting it up and down for ten seconds; take it out and place it face upwards in

another dish, half-filled with distilled water; allow the water to pass over the surface twice; take out the glass, rear it up to dry; it is ready for the camera, and will keep in this state ten days; of course shut up from daylight in a moderately warm place, but never moist.

The solution may be filtered into a black bottle, and will do again, by now and then adding a few drops of acetic acid, and keeping it in the dark.

Expose in the camera from four to ten minutes, according to the amount of light and the aperture of the lens. Suppose I say a lens of three inches diameter, sixteen in focus for parallel rays,—a one-inch diaphragm placed three inches in front of the lens, (one of Ross's photographic lenses is just the thing,) the exposure would be good light in about five minutes.

Fifth, develop as follows.—Place the glass, face upwards, on a stand with adjusting screws to make it level; pour a concentrated solution of gallic acid over the surface; the image will be from half-an-hour to two hours in coming out. It is best to apply a gentle heat, not more than 10° above the temperature of the room, the room being 60°. Should the image still be feeble, pour off the gallic acid, rinse the proof with water, and pour on to it equal quantities of acetone-nitrate of silver and gallic acid reduced one-half with water. The image will now develop quickly,—arrest it in four or five minutes,—wash it well in three waters,—fix with hypo-sulphite of soda, as follows:

Sixth, 3 drachms of hypo-sulphite of soda to 1 ounce of water. Allow the proof to remain in this solution until all the yellow iodide disappears,—wash it well,—rear up to dry,—and it is finished. Success is sure to attend any one practising this method, provided the eggs are *fresh* and the glass is *clean*: if the glass is not clean or the eggs stale, the albumen will split off in fixing.

Caution.—Wash all the vessels, as soon as done with, with nitric acid, and then with water. Every precaution should be used to avoid dust.

The albumen of duck's egg is more sensitive than that of a hen,—and from an experiment of to-day, I am almost certain that that of a goose is more sensitive than either.—*London Athenæum*.

STABILITY OF THE CRYSTAL PALACE.

From the Engineer and Architect's Journal.

It would appear that the doubts of the most eminent engineers, architects, and builders, as to the stability of the Exhibition Building, have had some weight with the Executive Committee and Contractors; for we learn, from the daily press, that in order to remove these apprehensions, the Executive have caused a series of experiments to be made upon a model gallery, erected for the purpose, which, for inapplicability and utter uselessness as a test, surpasses any thing in the annals of engineering jugglery that ever came under our observation.

Our readers will probably remember, that in addition to the many scientific men, possessing great practical knowledge and experience, who gave opinions adverse to the stability of the structure, was Professor Airy, the Astronomer Royal. He stated, that the Crystal Palace would, shortly after it was opened, tumble about the ears of those who unfortunately happened to be inside it, like a pack of cards.

At the meeting of the Institution of Civil Engineers, 21st January, 1851, it was shown by several of the most experienced members, that the roof had not been submitted to a fair test—that the snugs destined to support the girders of the galleries were too weak, and liable to fracture—that the concrete foundation was insufficient—the columns of too slender dimensions—and that the galleries would, under the tread of a multitude in one direction, acquire an undulating motion, which would fracture them.

The last argument appears to have told, more than any of the rest, upon the nerves of those who have the direction of the building; and, accordingly, to satisfy the skeptic and the ignorant—for none but the ignorant could be satisfied with such deceptive experiments—"a perfect bay of gallery was constructed, with its floor, binders, girders, and connecting pieces, in every respect complete and similar to the actual gallery, supported upon four points bedded on temporary foundations; rows of planks, the full width of the platform, led up to it and down from it, so that a row of men, as wide as the gallery, might be able to march up and down in close column. Three hundred workmen were first assembled by the contractors, and allowed to cover the platform and the

planks connected with it. They were then compressed into the smallest space upon which they could stand. The load borne on the planks represented the share of pressure which would be produced by the crowding of adjacent bays of gallery. The amount of deflection produced by this load was inappreciable. The men then walked regularly and irregularly, and ran over it. *The elasticity of the floor—allowing play to the timbers and wrought iron work*—was admirably developed by this test, and it became apparent that this quality of elasticity was of the greatest value in protecting the cast-iron girders from sudden shock. Thus, in the severest test which could possibly be applied—when the men, standing closely packed together, continued jumping simultaneously for several minutes, although in the regular vibrations of the floor *the binders played up and down*—the extreme deflection of any of the girders that could be ascertained at any moment did not exceed one quarter of an inch."

Who ever heard of the stability of a flooring increasing with its elasticity? Did Rennie or Telford, when they built the West India and St. Katharine's Docks, seek to increase the stability of the floors by making them elastic, or by giving "play to the timbers and wrought-iron work"? It ought, we believe, to have struck the least observant, that a platform on four short and stout columns, could afford no test of an elastic gallery flooring, 900 feet long, supported by slender columns at a height of 24 to 30 feet, and which ends abruptly in a transept. To have made any thing like a decent experiment, the bay should have been raised to the same height as the rest of the gallery, and then the three hundred workmen might have been set to run along the flooring. Can the gentlemen who were present—can the President and Vice-Presidents of the Institution of Civil Engineers, be ignorant of the structural changes of iron? Would they be satisfied of the stability of the whole building, if they themselves were responsible, with an experiment on a model of a portion of the flooring—24 feet square—not under the same conditions as the constructed work? Will they have the kindness to inform the public how this experiment with the

floor can demonstrate that the roof is perfectly secure,—or that the concrete is sufficient,—or that the columns are strong enough,—or that they will not shift upon their bases? Besides, if there be the traffic anticipated, the elasticity of the floor will be destroyed in a few days. And then, again, if there be this elasticity, it will have a tendency to work the columns out of a perpendicular.

The representatives of the daily press, who report with great simplicity the experiment played before them, were invited, but the representatives of the scientific press were not invited, nor does any one of the critics of the building, or of those impugning it, appear to have been asked. We miss, too, the Astronomer Royal. We are, however, most surprised at not seeing the names of the official referees among those who witnessed the experiments. Until their certificate appears, we can place no confidence in the stability of the structure; and, as a warning to intending exhibitors, as well as to the Executive, we beg to call their attention to the 15th section of the Metropolitan Building Act. It is full time that this document should be obtained and published, because the building is being used, and, if uncertificated, heavy penalties will have to be paid out of the funds of the Commissioners, and at a later period, by each individual exhibitor, who comes under the penalties of the act.*

SCHOOLS OF ART IN FRANCE.

From an Address by J. A. Hammersley, Esq., Principal of the Manchester Government School of Design, on the Preparations on the Continent for the Great Exhibition of 1851.

When I got to Lyons, I did not see a single evidence of any thing like silk design. I asked the director, who was

showing me round, upon what principle the school was conducted. He replied, "We teach in this way: we teach the pupils how to understand things." "But in this town," I said, "you manufacture silk. How do you educate your silk designers?" He took me to a table, and showed me a list of arrangements. "In the first place," he replied, "we have a professor of anatomy." Well, anatomy upon silk certainly appears singular, and I made that remark to him. The answer he gave me was, "There is a fine sense of proportion generated in the human mind by the study of anatomy, and the students obtain this fine sense of proportion by studying the marvellous anatomy of the human frame. There is the principle of anatomy." "Then," he said, "there is a professor of botany." There is a more obvious relation in botany as applied to design, than in anatomy. "We have a professor of botany then—a man who not only teaches how to draw flowers, but their construction and thorough analysis—the calix, the petals, the stamen,—because the designer sometimes wants only the calix, sometimes the petals, and sometimes the stamen, or the pistil. This professor tells you the whole principle of botany, and teaches you the beautiful construction of plants before he teaches you how to draw at all." This professor takes his pupils into the Botanical Gardens of Lyons, about two miles distant from the schools; and to see him going with the students to study the construction of flowers in those gardens was no small gratification to me, nor would be to you. He does not then see the poverty of cut or dried plants, but the vital reality of things. There are more suggestions for the textile designer in one foot of luxuriant wild herbage than in a dozen well-trimmed parterres. "Then," said my conductor, "we have a professor of landscape." "What has that to do with silks?" I asked. He replied, "The landscape student, if he be a right man, goes into the *abandon* of nature, which gives him a warmth that he could not otherwise obtain." Then there was a professor of ornament. I said, "I don't see any appearance of ornamental drawing." I was answered, "The professor of ornament has a room to himself; he takes a boy into it, and says, 'It is no use telling you how to draw

* That if before the certificate of satisfaction shall have been made, or if such further fourteen days as aforesaid shall have elapsed without due notice being given in writing as aforesaid, any such building subject to special supervision shall be used for any purpose without such express authority in writing, then, on conviction thereof before two justices of the peace, the occupier of such building, or other the person by whom such building shall be so used, shall forfeit for such offence a sum not exceeding 200*l.* for every day during which such building shall be used without having obtained such certificate of satisfaction, or such express authority as aforesaid; and that, in determining the amount of any such penalty, it shall be the duty of the justices and they are hereby directed to have regard to the size and character of the building, and to the nature and extent of danger involved in the use of such building, and to the amount of profit which might be derived from such use thereof.

correct ornament; but I will teach you what correct ornament means: I will teach you certain radical forms in Greek ornament that shall enable you to design to eternity, because you will know Greek ornament by heart.' And so with regard to other styles of ornament. The next professor was a professor of sculpture. I said, "That was not much wanted for silk." "No," was the reply, "but we have workers in relief, and it behoves the master to teach modelling, and not only to teach the manipulation of modelling, but the whole science of art in projection." Besides the above, there is a professor of engraving, who teaches the science of rendering the laws of color, and light and shadow, in the different medium of mere black and white. Then there is a professor of painting, who carries the pupil through the complex laws of color, instructing him in all the beautiful results of judicious opposition, or of exquisite harmony. Then there is a professor to teach every thing about architecture; and after him an elementary master, and a professor of geometry and perspective. Besides these professors, there is a principal of the school, who, in his own person, unites the artist, and the universal man of taste, with capacities eminently suited to the necessary managerial duties of conducting so important an institution.

"The Lyonesse School has a fund of £2500 a year, besides the ground and building, together with the museum, and the many other advantages which I have named. As an instance of the great power of the designers in Lyons, I may give a circumstance which came immediately under my own eye. I was in a room where there were several designers, all of whom had previously been educated at the School of Design, and were, indeed, members of it at the time of my visit. I was remarking to a manufacturer who was with me upon the great celerity with which one of the designers produced his own ideas. His movements were as rapid and as certain as the ordinary movements of the pen in writing. The gentleman to whom I spoke desired me to request from the designer a correct delineation of any flower which might occur to me; this I did, and not only did I have it immediately from his well-stocked memory, but I got a dozen of each for

which I asked, drawn in every possible position, and in every stage of growth.

LAMBERT'S ECONOMIC OIL LAMP.

Under this title Mr. Lambert has brought out a cheap modification of that form of lamp in which the oil is raised, not by the capillary action of the wick, but mechanically. The French lamps of this kind, in which the oil is pumped up by clockwork, are very perfect, but are expensive. The advantages of not depending on the capillary attraction are rather important. In the ordinary lamp the wick begins to char as soon as it is lighted, and gradually does so more rapidly as the thickening of the wick diminishes its capillary powers and the consequent supply of oil. The oil which is not perfectly consumed is also deteriorated, so that a certain quantity is always left in the lamp, which has to be thrown away. Lambert's lamp is in the fashion of a candlestick, the stem containing the oil, which is poured in at the top. Inside the stem slides a leather piston, over which is coiled a spiral spring, tending to depress it. To the piston is also attached a rod, which passes up to the top of the lamp, and has a button on the end. The wick is contained in a long tube nearly the whole depth of the lamp. When the lamp is to be used, after the wick has been threaded into the tube, it is put in its place, and the oil poured in through a valve at top; the piston is raised by the rod and button before described, and the oil which was previously on the top of the piston, escapes past the circumference, owing to the leather springing to admit of it, to the underside of the piston, by which it is forced, by the expansion of the spiral spring, up the wick tube to the top. Any oil which is not consumed runs down again into the lamp. The wick is about the size of that of a candle, and it gives about the same light, but more uniform and at a much cheaper rate, the oil being consumed to the last drop. Owing to the great length of the wick, much trouble is saved in the trimming, as one will last a long time. We have tried one of the lamps in our office for a fortnight, and find it a convenient substitute for a candle, as no grease can fall from it, and there is no

guttering down. Its superiority in this latter respect may lead to its adoption in warm climates, where the unsuitability of candles is more strongly felt. There are one or two points about the lamp which might perhaps be modified to advantage, but we have no doubt its success will lead to further improvement.

“ON THE IMPORTANCE OF MAKING A COMPENSATION FOR THE PULL OF THE AIR-PUMP BUCKET IN THE CONDENSING STEAM-ENGINE.” By Mr. George Heaton, Birmingham.

In the year 1844, the author of the present paper was employed to inspect and ascertain the cause of the irregular motion and inefficient performance of a steam-engine and mill, used for the purpose of grinding corn. The mill had nine pair of corn stones, five on one, and four on the other side of the driving power. The bottom of the corn spindles frequently moved, and strained the whole framing which carried them, those most distant from the power having the greatest strain, frequently moving a quarter of an inch, and the end of the horizontal shaft which drove the corn spindles partaking of the same movement, and becoming much heated with its work, and the teeth of the wheels much worn on both sides.

The mill-work was very good and substantial, and had been about four years at work. The steam-engine, with cylinder 40 inches diameter, stroke of piston 6 feet, air-pump 26 1-2 inches diameter, and 3 feet stroke, was altogether a strong, well-built engine; the steam pressure was about 6 lbs. per inch, and the engine was working at 17 3-4 strokes per minute; but, if attempted to be run faster, a much more irregular motion was produced. The governor was driven with gear, at the top of a vertical shaft 14 feet long, and the balls of the governor frequently moved in and out 4 or 5 inches during one stroke of the engine. When running at the speed of 17 3-4 strokes per minute, the governor rod, at the throttle-valve lever, frequently moved 3-4 to 1 inch during each stroke of the engine, the greatest opening of the valve being invariably at the end of the pull of the air-pump bucket; there was a great variation in the distance the rod moved

each stroke, moving the farthest every fourth or fifth stroke. The engine appeared to have too much lead, for the reversing blow was struck before the crank arrived at the centre. The time of opening the valves was therefore altered, effecting a saving of steam, and requiring the governor rod to be shortened more than one inch (the throttle-valve lever being 12 inches long); however, the irregular motion continued, and the engine, with nine pair of stones, appeared to have too much work.

The engine was constructed according to the general practice, to have about an equal weight hanging upon each end of the beam; the weights of the different parts were stated to be as follows:—

At the Crank End.

	T.	cwt.	qrs.	lbs.
Connecting rod and block at the top,	1	11	3	14
Four brasses,	0	0	2	0
Cold water pump bucket and rod,	0	2	2	0
Crank and pin,	0	14	3	0
Feed-pump, plunger, and rod,	0	2	0	0
	2	11	2	14
Deduct for weight of crank balanced on the main shaft,	0	9	0	0
Total weight,	2	2	2	14

At the Cylinder End.

Piston rod,	0	4	1	19
Piston and ring,	0	14	1	0
Pins, gibs, and cotters for ditto,	0	1	0	21
Parallel motion,	0	11	3	0
Cap and gudgeon to piston rod,	0	4	0	0
Plug rod,	0	3	2	0
Air-pump bucket,	0	4	2	0
Total weight,	2	3	2	12

consequently, the weights at each end of the beam were balanced within 1 cwt.

The following alteration was then effected in the engine:

A weight was fixed at the crank end of the engine beam, to assist in the pull of the air-pump bucket, and retard the speed of the engine on the opposite side of the stroke. This weight was 19 cwt. 3 qrs. 14 lbs., and from its position it was equivalent to about one-half the pull of the bucket, considering the average pull through the whole lift. The engine beam was double, and the balance weight was fixed between the two sides of the beam; also the governor was altered to be driven by a band instead of the former gear and long shaft. The engine was then set to run at 19 1-2 strokes per minute, the speed required by the Company for its work, so as to drive the stones at about 128 revolutions

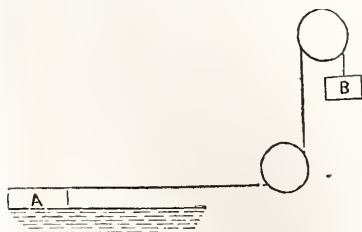
per minute, instead of about 117, the former speed; the corn spindles then ran quite steady, the necks of the horizontal shaft kept cool, the dust remained on the back part of the teeth of the driving wheels, and the governor rod remained steady for a long time together, without any thing else being done to either the engine or mill. Since that time, the Company have added five pair more corn stones to that end of the shaft the five pair are at, and they run equally steady with the others. The engine appears now to drive thirteen pair of stones with greater ease and freedom than it drove eight pair before the balance weight was added, and the repairs have been considerably diminished in the same space of time.



LAW OF RESISTANCE TO THE PASSAGE OF BODIES THROUGH WATER.

To propel a vessel at a certain speed, a certain quantity of water has to be disturbed, and if we call this supposed speed 1, and the supposed quantity of water disturbed likewise 1, then the resistance will be represented by $1 \times 1 = 1$; but if we double the speed, double the quantity of water will have to be displaced at double the velocity, or $2 \times 2 = 4$. Thus we see that the resistance is as the squares of the velocity—this being granted, it may easily be shown that the power required to propel a boat is as the cubes of the velocity.

In the following diagram, let A represent a boat, and B a weight over a pulley. Then the weight required to produce dif-



ferent speeds will represent the resistance and the velocity with which B descends multiplied into its weight will represent the power. Let us, in the first place, call the speed 1, and the weight necessary to produce that speed likewise 1; of course

the weight will descend with a velocity equal to 1, and the velocity multiplied into the weight or $1 \times 1 = 1$ of power, whereas if we double the speed, four times the weight will be required, and, of course, B will be equal to four, and will fall at a velocity equal to 2, or the velocity $\times$ weight $= 2 \times 4 = 8$ of power, which is as the cubes of the speeds. J. B. G.

Another Solution.

A correspondent, "A. B. C.," inquiring why in a body moving through water, the velocity was said to be as the cube root of the power, he being at the same time aware that the velocity was only as the square root of the resistance, and consequently of the force or pressure required to propel the body.

In order to understand this apparent paradox, he must make a distinction between pressure and power. Take for instance a horse hauling a boat along a canal. The force or pressure is the strain the horse exerts on the towing rope—the power is this force multiplied by the distance over which the horse travels. It is evident from this definition that if the speed of the horse is increased, the power is increased in any given time in the same ratio, independent altogether of any increase in the strain on the rope. But, by increasing the speed, the strain is also increased as the square of the velocity. Now, the power being the product of the distance passed over and the force exerted, the former varying as the velocity, the latter as the square, the power must necessarily vary as the cube of the velocity.

It must be kept in mind, however, that the power varies in this ratio only for equal intervals of time. It varies as the square of the velocity for equal distances passed over.

For example, if the ocean steamers could double their speed, so as to cross the Atlantic in five days instead of ten, as at present, they would encounter four times the resistance, and expend only four times the power in overcoming it during the voyage; but this quadruple power would be expended in half the time, and of course eight times the quantity required at present in any given time. The engines would then require four times as much fuel during the en-

tire voyage, and eight times as much per day.

S. G. S.

EDINBURGH, January 8, 1851.

CAMEO CUTTING.

The term *cameo* is frequently applied to works in shell, but we believe it to have been originally wholly applicable to the engraving in relief of gems. We describe both methods.

The method of *carving* cameos in conch shell, is more expeditious, and presents much less difficulty, than the engraving of cameos on gems, but the shell cameos do not admit of the delicate cutting and elaborate finish usually bestowed on true cameos, and they are also much less durable.

Shell Cameos.—A very suitable material for cameos is found in the various conch shells or *Strombs*, the substance of which consists of two distinct layers of different colors, textures, and hardness, and which may be considered respectively to partake of the nature of nacreous* and porcelaneous shells. The outer coat or layer in the most suitable specimens of conch shells is nearly colorless, of uniform texture, and like that on the nacreous shells admits of being readily operated upon by steel cutting tools, and which may be made to produce a smooth and well-finished surface; this outer layer is therefore suited for the carved parts of cameos, the ground being formed of the under layer of the shell, which in the most suitable kinds is of a dark color and allied to the porcelaneous shells, being somewhat brittle and so hard and compact as not to admit of being readily cut with steel tools.

The best kind of conch shell for carving into cameos is found on the Southern coast of America, and also on the coast of the West India Islands, and commonly known as the "*black conch*;" in these shells the contrast of color is the most decided, the under layer being very dark or nearly black, especially in the old or full grown shells, which are the hardest and most compact, and also possess the greatest amount of the white or outer layer, the part to be carved. In the pink conch shell the contrast of color is not so

great, and as it does not at all resemble the onyx in which antique cameos were cut, it is but little used for the best works; nevertheless, some very beautiful specimens of carving on the pink conch shell are to be met with, and the delicacy of the colors gives a very pleasing effect.

The most suitable shell having been selected, it is cut into pieces of the required forms for the cameos; this process, which must be cautiously performed, is best effected by means of the slitting mill fed with diamond powder, described in the chapter on Lapidary Work, but the cutting may be also effected with a blade of iron or steel, such as a thin table knife blade notched to form teeth, and fed with emery and water, a process similar to that by which the stone mason cuts slabs of freestone and marble with a smooth blade of iron fed with sand and water.

The piece of shell having been cut out is next carefully ground to the general form of the cameo, as square, lozenge, elliptical or other shape, upon an ordinary grindstone, the face and back of the shell being also levelled and reduced to the appropriate thickness. A slip of Turkey oilstone may be used with advantage to give the last finish to the edges of the shell after the upper white layer has been removed from it, for when the shell has lost the support of the white layer, it will be found that the coarse cut of the grindstone will fill it with minute cracks, which frequently spread over the surface after the cameo has been some time finished.

Having prepared a piece of shell of the desired form and thickness, it is next cemented on a block of wood about three inches diameter, or of a convenient size to be grasped firmly in the hand; care should be taken to place the piece of shell level and near the centre of the block, in order that all parts of the cameo may be operated upon with equal facility. Now sketch with a pencil the contour of the subject to be carved, and follow this pencil-mark with a scratch point; having removed the surrounding white substance by means of files and gravers, proceed to develop the figure by the use of smaller tools. A very convenient form of carving tool for this purpose may be made of pieces of steel wire about six or eight inches long, flattened at the ends and

* So named from nacre, the French for mother-of-pearl. The porcelaneous shells resemble porcelain, and are usually univalve, whereas the former are usually bivalve.

hardened; they are lastly ground to an angle of about 45 degrees, and carefully sharpened on an oilstone. The largest tools may be made of wire about one-eighth of an inch diameter; smaller wire will serve for tools of a medium size, but for the smallest tools an ordinary darning needle left quite hard, and ground to the same angle, when inserted in a wooden handle, will be found very useful in deepening the finer lines. The advantage of this form of tool consists in the absence of any angles that would be liable to scratch the work, and a tool thus formed admits of being used either as a gouge, or as a chisel, according as the flat or round side is brought to act on the work.

To guide the tool in the act of cutting, the left hand should grasp the block upon which the cameo is cemented, the thumb being placed close to the cameo; the tool held in the right hand should be so rested against the thumb of the left hand as to form a fulcrum, upon which the tool may be moved as a lever in short arcs of the circle, with a scraping action which removes the material as a powder, care being taken that every cut is made obliquely downwards towards the black ground; should any of the cuts be made towards the surface, or even parallel therewith, there would be danger that small pieces would be chipped off, and which would be destructive to the cameo.

As in all other processes of producing form by reduction, the general shape should be first wrought with care to leave every projection rather in excess, to be gradually reduced as the details and finish of the work are approached. To render the high parts more distinct during the process of carving, it will be found convenient to mark them slightly with a black lead pencil. Throughout the cutting great caution should be observed, that in removing the white thickness, the dark ground is not damaged, as the natural surface of the dark layer is far superior to any that can be given artificially; indeed, should the ground be broken up at one part, it would be requisite from its lamellar structure to remove the entire scale or lamina from the whole surface, a process that will be found very tedious, and much more difficult than the separation of the white from the black thickness.

In order that the finished cameo may possess a distinct outline at all points of view, it is desirable to adopt the system followed in antique cameos, namely, to leave all the edges of the figure quite square from the ground, and not gradually rounded down to the dark surface; should this latter method be followed, it will be found that the outline is in many places undefined, owing to the color of the white raised figure of the cameo gradually merging into that of the dark ground; this evil is entirely avoided by leaving the extreme edge of the figure quite square, for about the thickness of one-fiftieth of an inch.

The surface of the cameo should be finished as nearly as possible with the cutting tools, as all polishing with abrasive powders is liable to remove the sharp angles of the figures, and deteriorate the cameo by leaving the form undefined. When, however, the work has been finished as smooth as possible with the cutting tools, the final polish may be given with a little putty powder used dry, upon a moderately stiff tooth brush, applied with care, and rather to the dark ground than to the carved surface: this is the concluding process, after which the cameo is ready for removal from the block prior to mounting.

Cameo cutting, or the engraving of gems in relief, is effected with the same apparatus, and by the same general methods, as those employed in engraving corresponding forms in intaglio, and both arts are occasionally practised by the same individuals. The principal differences in the manipulations of the seal engraver and the cameo cutter arise from the design being in the former case wrought concave, and in the latter convex. The tools with which the former are produced, being themselves convex, they may in most cases be selected of counterpart curvatures to the concave details required in intaglio engraving; but the convex forms in cameo cutting have to be produced with convex tools, which cannot therefore be selected of counterpart forms, but the convex surfaces have to be produced by twisting the stone about at all angles beneath the rounded edge of the tool. For this reason the engraving of gems in relief is usually considered to be more difficult than engraving in intaglio. On the

other hand, however, the deep recesses in cameos are generally more accessible than those in intaglio, and the principal source of difficulty in gem engraving is therefore in some measure avoided.

The stones selected for engraving in cameo are generally those called onyxes, consisting of two layers of different colors forming a strong contrast, as the black and white layers of the agate, or the red and white layers of the carnelian. The design is almost always engraved exclusively in the white layer, and the dark colored layer forms the background, the contrast of the two colors serving to render the design more distinct. Sometimes onyx stones having three or more layers of colors are employed for cameos. These are selected when either from the great amount of relief desired in the engraving, the thickness of the white layer would be insufficient to allow of the entire design being engraved in it, or that it is desired to make the most prominent parts of the design of different colors in order to improve the effect.

Mineralogists generally restrict the name *onyx* to a variety of chalcedony, consisting of alternate layers of brown and opaque white, but those artists who work in precious stones usually attach a much more extended signification to the name, and the following interesting particulars from the pen of Mr. H. Weigall will explain the cause of these discrepancies:

"All the stones in different colored layers employed for cameos, are known to *practical men* by the general name of onyxes; but some confusion has arisen with regard to the nomenclature of stones of this class, in consequence of the imperfect information of those authors who have undertaken to describe them. It is a remarkable fact that no author who has undertaken to describe the onyx, has given this simple, and to all practical persons, intelligible, description of it, namely, a stratified stone occurring in any of the semi-transparent or opaque varieties; thus there is the onyx of the sard, called the sardonix, that of the carnelian onyx, and so on through the whole variety of stones.

"The name onyx is derived from a Greek word which signifies nail, and the authors before referred to, have evidently been perplexed to make out any resem-

blance between such an object, and that particular variety of the onyx which they happened to describe. Thus Pliny could see no resemblance to a human nail in the specimen from which he took his description of the onyx (which appears to have been a bad sardonix), and he therefore thought it must be a horn or hoof, and fancied a resemblance to a horse's hoof. Theophrastus seems to have described a cloudy specimen of the carnelian as the onyx, and he fancies it resembles the pink and white colors sometimes observable on the human nail."

Mr. H. Weigall however suggests that there was an original propriety in the name, and that it most probably arose from the practice of the ancients in staining their nails, for if the stain were only applied at distant intervals of time, the lower portion of the nail would grow between the applications, and present a band of white at the bottom of the colored nail, and thus render it a fair type of the onyx stone.

Mr. Weigall has made inquiries of travellers who have visited those Eastern nations where the practice of staining the nails is still continued, and has found this view to be corroborated, as they agree in stating that the nails commonly present two colors exactly resembling an onyx.

The stones to be cut into cameos are prepared by the lapidary, and to avoid wasting the material, each stone is left as large as possible. The cameo cutter has therefore to select a stone as nearly as he can in accordance with his intended design, which must be afterwards modified in some degree to suit the stone.

As a preliminary step to cutting the cameo, it is most important that the artist should have a clear conception both of the design, and the capabilities of the stone. To assist in this, he first makes a sketch of the design on an enlarged scale, and then having considered the degree of relief, that will be adapted to the thickness of the white layer, he makes a model in wax of the exact size of the stone.

With unimportant works this is frequently omitted by practised artists, who depend upon their skill for overcoming any difficulties that may arise, but it is at all times a great assistance in elaborate works, especially to those who have not great practice. The model and stone are carefully compared, and any alterations

that may be demanded by the formation of the stone, are first made in the model.

When the stone is in three layers, additional care is required to adapt the design to the stone. It is at all times desirable that the line of division between the colors of the two layers forming the ground and figure should be distinctly defined, but it is sometimes an advantage when the transition between the two colors in the upper layers is more gradual. For instance, in cutting the head of a Medusa, in a carnelian having one layer of white between two of red, if the lines of division between both the layers of red and the white were sharply defined, the features must be cut entirely out of the white layer, and the upper layer of red must be reserved for the snakes, but if the transition between the upper layer of red and the white were gradual, a faint tinge of color might be left on the cheek with great advantage to the effect, and the skilful engraver of cameos will thus avail himself of every opportunity for heightening the effect that is offered by the formation of the stone. When the stone consists of several layers of color, considerable scope is afforded for the exercise of the judgment, in selecting a design in which the whole of the colors can be rendered available.

When the design has been accommodated to the stone as nearly as possible, the outline is sketched on the surface, and cut in with a knife-edged tool, and the superabundant portions of the white layer beyond the outline are removed down to the dark layer forming the ground. The general contour of the figure is next formed, and this is followed by the principal details, which are sketched and cut in succession, care being taken to preserve sufficient material at the most prominent parts, and to advance the engraving uniformly, so that the general effect may be compared, from time to time, with that of the wax model.

The surface of the background is conveniently flattened with a broad flat tool, and the difficulty of removing the little irregularities on the rounded surfaces of the figure, with the convex edge of a revolving tool, may be entirely avoided by the use of a tool called a *spade*, consisting of a piece of soft iron about three or four inches long, the end of which is filed at an angle of 45 degrees, and charged with

diamond powder. The spade is held in the fingers like a pencil, and rubbed with short strokes, either straight or circular, to reduce the irregularities of the surface. The last delicate touches are executed with very small tools, and the cameo is finally smoothed and polished in the same manner as the best works in intaglio.

CHEMISTRY APPLIED TO ARTS AND MANUFACTURES.

From the Chemical Gazette.

On the Preparation of Green and Gray Colors from Oxide of Chrome, for Calico Printing. By Dr. W. H. DE KURRER.

Printing with two Green Colors.—When, by means of a reserve of arsenate of potash, figures dyed red or violet by madder are stopped out, and the white parts of the fabric printed by hand from a design in relief, with a solution of chloride of chromium thickened with starch or gum-tragacanth, then, by afterwards printing over this with sea-green, by means of the cylinder, a dark green pattern will be obtained upon a light gray ground; and after applying the other colors requisite for completing the design, the fabric is passed through a bath of acetate of copper to brighten the greens.

Chrome-olive.—Very fine and fast olive colors may be obtained suitable for cylinder printing (upon which yellow patterns may be produced by acetate of lead) by means of the following preparations:—

1. *Light Olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 2 litres of catechu-brown.

2. *Medium Olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 2·350 litres of catechu-brown.

3. *Dark Olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 3·560 litres of catechu-brown.

The catechu-brown, which is added to the oxide of chrome or sea-green to form olive colors, is prepared by dissolving 2·5 kilogrms. of Gambia catechu in 10 litres of water over a gentle fire, and straining the decoction through a fine sieve; 2·375 litres of this solution are

then boiled with 0.150 kilogram. of starch, 0.090 kilogram. of verdigris, and 0.120 kilogram. of sal-ammoniac.

The day after printing, the olive colors may be brought to any desired shade by the following means:

1. To produce a brown tint, the pieces are introduced into a vat furnished with a drum, and containing milk of lime (at a temperature of 104° F.), and afterwards carefully washed. 2. In order to approach nearer to an olive-green, instead of milk of lime, they are passed four or five times over the drum (a single piece at a time, and in one direction only), through a bath of acid chromate of potash. 3. When it is desired to bring the above colors to a more decided green, the pieces, after having received all the colors required, viz., the yellow, the fast blue and green, and also the sea-green, are passed through a bath of acetate of copper heated to 140° F.

Pearl-gray Color for Printing.—This pleasing color is obtained by means of sulphate of chrome and of potash (chrome-alum). It is prepared in the following manner: Into four large stone vessels are severally poured 2 kilograms. syrup of sugar and 2 kilograms. of thick gum-water, prepared by dissolving 1.50 kilogram. of gum in 1.25 litre of water. Into each vessel a hot solution of 2 kilograms. of bichromate of potash in 6 litres of water is then poured, the mixture being briskly stirred. After being allowed to cool down to 86° F., 2.50 kilograms. of colorless sulphuric acid diluted with water (say 2 kilograms. acid and 3 litres water) are added, again stirring briskly. After the lapse of a short time, the liquor will become spontaneously heated and rise rapidly. In order that no loss may arise, the liquor which may overflow should be received in another vessel. The color gradually changes from orange to olive-green, and finally to dark gray. It must be stirred from time to time, until the liquor ceases to froth up, when it will be found to have acquired a fluid consistency and a blackish-gray color. As soon as the rising ceases, that which had overflowed is poured back again, and when perfectly quiescent and cold, the contents of the four pots are mixed together, when the liquor will be ready for use, it being found to consist of a compound or mixture of sulphate of

chrome, with sulphate of chrome and potash (chrome-alum).

This color will be found well adapted for cylinder-printing, which is performed in the ordinary manner of printing with starch colors, viz., by introducing a cylinder provided with a woollen band into the dye-vat, from which the color is fed to the engraved cylinder. Ten pieces of calico may be easily printed off with this color without changing the doctors, as they are not affected by it.

The next day after printing the fabrics are stretched upon frames, and immersed during six minutes in a vat filled with milk of lime; they are then left for an hour in running water, and passed through a bath of hot water to dissolve all the reserve, in order that this may be completely washed out in the washing machine, and they are afterwards dried.

Green Patterns upon a Pearl-gray Ground.—These may be obtained perfectly fixed by preserving the madder-reds and violets with the reserve of arseniuret of potassium, then printing on the white ground the patterns in sea-green, and afterwards with the cylinder applying the pearl-gray color.

Yellow Patterns on a Pearl-gray Ground.—These are produced with the preparation of lead, in the same manner as above described for sea-green.

Yellow, green, blue, and catechu-brown colors may be advantageously applied to the above; and in passing through a bath of milk of lime and another of yellow and neutral chromate of potash, the yellow and green will be brought out and the catechu-brown fixed.

The bath of neutral chromate of potash, for bringing out and fixing the colors, is prepared in the following manner:—Into a vat, provided with a drum, and three parts filled with water, a solution of 3 kilograms. of neutral chromate of potash is poured, to which are added not more than from 4.750 litres to 5 litres of vinegar, in order that it may not be acid, as bichromate or acid chromate of potash would convert the pearl-gray into chromate of chrome, which is of a brownish-yellow color. The yellow, to be good, should appear in the bath of neutral chromate of potash of a brimstone color, the green having always, on the contrary, a pear-green tinge; consequently, in printing in pearl-gray, should a fine

grass-green be required, a good steam color must be resorted to.

Pearl-gray approaching to Blue.—To produce this color, the sulphate of chrome and potash must be prepared as follows: In 6 litres of water, 4 kilogrms. of bichromate of potash, in small pieces, are dissolved; 2.5 kilogrms. of colorless sulphuric acid are diluted with 2 litres of water, and this dilute acid, when cold, is poured slowly into the solution of chromate, which is stirred; then add 2 kilogrms. of powdered sugar, in small portions at a time, which addition will cause an elevation of temperature and great effervescence. When the mixture is cold, the sulphate of chrome and potash possesses a certain degree of consistence; and, for printing, the following proportions of syrup and British gum are added as thickening matter:—1st, 2.375 litres of syrup are diluted with 2.375 litres of water, and added to 4.750 litres of solution of chrome-alum; 2nd, 3 kilogrms. of British gum are boiled in 3 litres of water, and after complete cooling are poured into 4.750 litres of the solution of chrome-alum. Neither dry gums nor gum-water will serve as thickeners for this color, as gums contract and form with the double sulphate of chrome and potash a hard matter resembling leather. The printed fabrics are next day passed through milk of lime, and treated in the manner above mentioned. If to 12 litres of the pearl-gray about 1 litre of the catechu color, prepared in the same manner as for chrome-olive, be added, a peculiar reddish-gray color will be produced.

Chrome-green Printing Color.—A very fine green color (suitable for printing stripes upon cotton) may be produced by preparing chloride of chromium in the following manner:—4 kilogrms. of pulverized white arsenic are dissolved in 106 litres of water by the application of heat; 3.5 kilogrms. of bichromate of potash are also dissolved by heat in 14 litres of water, and this solution is poured slowly (stirring continually) into the arsenious solution. After cooling, the green precipitate is thrown upon a cloth, and when well drained, 5 kilogrms. of hydrochloric acid of 22° Beaumé are added to it; it is then dissolved in a sand-bath, and evaporated to 4° Beaumé, neutralized by means of 1.750 litre of soda ley at 20° Beaumé, stirring continually; and, finally, the liquor

is thickened with 100 grms. of gum-tragacanth, finely powdered, when it will be fit for printing. The fabrics thus printed are left for twenty-four hours in a cool place, and then dried.

Steel Green-gray Steam Color.—To prepare this color, which is chiefly employed for printing cotton stripes, the chrome-alum is prepared as follows:—Into a solution of 7.5 kilogrms. of bichromate of potash in 15 litres of water pour slowly 4.625 kilogrms. of colorless sulphuric acid, and mix gradually with the liquor 1.875 kilograms of raw sugar. The stone vessel in which this solution is effected is kept hot in a sand-bath until the mixture has acquired an emerald-green color, when it may be left to cool.

Color for Printing.—To 2.375 litres of starch-paste, prepared with 0.360 kilogram of that substance, are successively added 7.125 kilogrms. of chrome-alum, 6.5 kilogrms. of catechu-gray, and 0.900 kilogram of acetic acid of 3° Beaumé.

To prepare the catechu-gray, dissolve 4 kilogrms. of Gambia catechu in 24 litres of wood-spirit, and add 1.780 litre of gum-water for each 1.780 litre of the catechu solution. The gray color is finally obtained by the addition of 0.060 kilogram of green vitriol.

This color requires most particularly to be steamed, as the green and other steam colors, which are easily affected, would be changed by the acetic acid, which is otherwise carried off in the form of steam.

TURNING AND MECHANICAL MANIPULATION.

We extract from the third volume, just published, on turning and mechanical manipulation, by Holtzapffel, the following, as an example of the mode in which a common technical subject can be illustrated:

The restoration of the edges of most cutting tools for wood and soft substances is effected by the successive action of the grindstone and oilstone, the former being employed to remove the principal bulk of the material, so as to prepare the tool for the action of the slower but more delicate oilstone, which produces a much keener and more accurate edge than can be obtained with

the grindstone. Tools for cutting the metals and hard materials are frequently left from the grindstone without the application of the oilstone, which is chiefly resorted to for setting a smooth edge upon the finishing tools.

Tools that are required to possess a delicate edge of a definite form, should in all practicable cases be ground upon the one bevel only, the second face then admits of being carefully formed in its manufacture, and the accuracy thus given should be scrupulously maintained, as it is clearly much easier to produce the required form by the abrasion of the less important face, than when both angles of the edge have to be renewed every time the tool is sharpened. For example, the axe and chipping chisel, which require considerable strength, and but a moderate amount of accuracy, are commonly ground with two bevels, while the plane iron and paring chisel, which require accurate edges and greater delicacy, have the one face made quite level in the first instance, and in the process of sharpening, the second face of the angle is alone operated upon; in screw tools, and moulding tools for turning, this is still more imperative. The razor, which requires delicacy of edge rather than accuracy, is sharpened on both faces; but in this case, as will be shown hereafter, the back of the instrument serves as a guide for the formation of the edge.

The grindstone should be kept in order so far as possible by the equal distribution of the wear; narrow tools especially, should be constantly traversed across the face of the stone to avoid wearing the latter into ridges, and the extreme edges of the stone should be exposed to their fair amount of work, or otherwise the stone will become hollow and unfitted for grinding broad flat tools. By the equal application of the tools, the face of the stone may be kept tolerably flat with but little recourse to turning or hacking. When, however, the stone loses its circularity, or becomes eccentric from being worn irregularly, it is better at once to resort to one of the means of correction, as otherwise the stone becomes rapidly worse, and the difficulty of holding the tools steady is considerably increased.

As a more scientific way of keeping grindstones in order, it has been proposed that two grindstones should be mount-

ed with their axes parallel, and adjustable by a screw to keep their surfaces always in contact, and by giving them different surface velocities they would respectively abrade and correct each other; but the contrivance, although simple, is too refined for the majority of the grinders' shops, and is scarcely required for the limited purposes of the amateur.

The flat side of the stone is but little used, notwithstanding that its broad surface appears so suitable for the purpose, but which is certainly not the case; in the first place, the spindle would be found to be in the way of large tools or their handles; and secondly, the constant reduction of the stone arising from the friction of the work rubbing away its granular particles, would soon cause the flat surface to degenerate into an imperfect cone, and would leave a lump in the centre, or if the stone were kept perfectly flat, it would be at the expense of its thickness, and the wedges by which it was first secured would be gradually exposed and loosened.

The stone is turned either to or from the operator according to circumstances, and in all practical cases it is best that it should run towards the extreme edge of the tool, and not from it, as in the latter case the last portion bends away from the stone and leaves a film or wire edge upon the tool, which the reverse direction avoids. The edges of the tools should be always ground parallel to the axis of the stone, or *transversely*, and not in the direction of their length, as the former position makes their edges concave to the same radius as the stone, and therefore keener and better prepared for the action of the oilstone.

In grinding the *ends* of rectilinear tools the stone should run towards the operator, as in turning; and for their *sides* or edges, it is perhaps the most convenient that the stone should travel the reverse way or backwards. Pointed tools are ground much the same as flat tools; but the choice of method is in some respects a matter of personal convenience.

In grinding the bevels and edges of instruments in their manufacture, the workman is seated on a board called the *horse*, and generally rests his elbows on his knees for steadiness. The work is mostly applied to the stone by the hands alone, without the employment, except in rare

cases, of any guide beyond the sense of touch, which some of these workmen possess very acutely; and the amateur will find it desirable, and sometimes imperative, to trust to the feel alone in holding the tool upon the grindstone.

To grind the various tools with an uniform bevel requires considerable practice, as, of course, the least variation or tremor of the hand makes a corresponding irregularity in the bevel; after a time, however, the fingers acquire considerable sensibility, and readily appreciate when the tool lies fair and flat upon the stone. In some cases even the practical men apply the tools upon a guide block, that bears the same relation to the periphery that should exist between the respective edges of the tools—that is, if the edge of a tool is required to be exactly at right angles to the broad surface of the same, the guide upon which it is applied should point directly to the axis of the stone, or be as a radius. If the tool should differ 10 or 20 degrees from the right angle, the rest is inclined upwards or downwards to the same angle. There are also instruments in which the rectilinear tool is grasped, so that the end to be ground forms with the two legs of the instrument a triangular base; the feet are applied to some fixed plane surface, and the tool or the third leg rests upon the grinding surface.

The broad flat surfaces of tools are traversed quickly to and fro upon the top of the grindstone, as a short period of rest would grind a hollow place of the same curvature as the edge of the stone; and it is to lessen this evil, as far as possible, that the largest stones are employed for saws, the sides of which are required to be flat and parallel. In the razor, on the other hand, the curvature is desirable, and the 4-inch stone is there the nominal desideratum; still smaller grindstones are very often employed.

CLAY AND IRON RETORTS.

From the Journal of Gas-Lighting.

BY A PRACTICAL MAN.

SIR:—There is much difference of opinion existing at present on the relative economy of clay and iron retorts; and the difficulty in the way of arriving at a just knowledge of their respective merits is greatly increased by the partial and prejudiced statements of those who have

become enamored of one or the other. The fact of each doing well in particular places would lead the impartial observer to the idea that local circumstances, such as the value of iron, fuel, and gas, may have considerable influence in the adoption of either. This view, however, is seldom taken; for we frequently meet engineers who are wholly absorbed in one system or the other, each relying upon experiments of the most opposite and contradictory character.

The difficulty in examining this subject is hence great in proportion to the mass of conflicting evidence, and, if we should fail in clearly demonstrating which is the most beneficial, the arrangement of matter to be debated will probably assist an abler pen in making a clearer demonstration.

It is asserted, on the one side, that the original cost of clay retorts is less, and their durability greater, than iron; that they evolve more gas of a better quality, are less subject to carbonaceous deposit, and require the same amount of fuel (some, indeed, assert less, but this is scarcely credible).

On the other side, it is urged that clay is porous (more especially when new), and allows much of the gas made to pass by insensible perspiration into the flues; that clay retorts are unmanageable and crack when their temperature is reduced; that carbonaceous deposit is greater in them than iron; that, although more gas can be made from them under favorable circumstances, the average amount per ton is less; that, even when apparently greater, it is an attenuated gas due to high heats and carbon deposited; that clay, being a bad conductor of heat, requires more fuel—which disadvantages more than compensate for the greater price and more rapid decay of iron.

These are the assertions made, and they are sufficiently numerous and conflicting. I will diminish their number before entering upon the argument; for I believe that carbonaceous deposit is not induced by the material of which retorts are made, but principally by the temperature at which carbonization is carried on and the surface exposed, and *partially* by the density of the gas caused by additional pressure.

The material can have little effect after the first film is deposited, as it will be

then clearly carbon attracting carbon in both cases.

There is certainly, to all appearance, less deposit in clay for the first few months; but it is highly probable that, during this time, the pores of the clay are becoming saturated, for we know that this saturation may be traced through the whole thickness when the retort is removed from the furnace, and a sectional fracture made in it. Iron, on the contrary, being much less porous, receives the deposit from the first, but (being generally worked at a lower heat) to a less extent.

While upon this subject I may remark that the effect of pressure in producing deposit is much over-estimated. Gas, during its manufacture, has a density due to the pressure acting upon it, that is, thirty inches of mercury due to the atmosphere, and say one inch additional from gasholder, hydraulic dip, &c. Now, if by mechanical means, this one inch extra is removed, the density of the gas will only be diminished by about three per cent., which is too small a difference to have any perceptible effect. Indeed the alteration of the barometrie column from thirty to twenty-nine inches would have an equal influence. It has been asserted by Mr. Grafton and others, that reducing the pressure to level gauges will materially diminish the deposit, or altogether arrest it. This, I think, is an ill-founded assertion, and totally opposite to experiment, as well as to what might be expected from an investigation of the effects of a slightly reduced density. Having thrown aside the deposit of carbon as irrelevant, the question will assume a simple form. Thus:—

The cost of maintaining clay against iron.

The gas produced from each per ton, the volume being multiplied into specific gravity; and

The fuel required by each.

I will first investigate the cost of maintaining each. And here it is evident that the advantage is on the side of clay; the only difficulty will be in determining the true amount. If we take the circular, of the clay retort makers, they certainly overrate the saving.

A statement has been published giving the experience with clay and iron retorts at the Dunfermline Gasworks. From this the average cost of iron is £161 5s. 6d.

upon 18 retorts, making 5,104,000 cubic feet per annum; and for ten clay retorts, making 7,500,000, £19 5s. 7d.

If allowance be made for the extra quantity of gas made in the latter, this sum would be reduced to £13 2s. 4d., making the difference between iron and clay for 5,104,000 per annum to be £148 3s. 2d., a difference in the cost of gas of 7d. per 1000 feet. Now, although it is hardly courteous to question the truth of a statement of this kind when attested by the manager where the events take place, still we cannot help noticing that the statement bears internal evidence of partiality, or carelessness in the use of iron. £161 5s. 6d. is more than sufficient to have reset the whole of the retorts used; and, if such were the case, then each, while it lasted, only produced 283,000 cubic feet of gas, about equal to the produce of 100 good working days. To speak of burning out retorts at this rate is a gratuitous advertisement of the want of skill in the manager.

The tear and wear of the retorts would be, by this statement,—iron $7\frac{1}{2}$ d., clay $\frac{1}{2}$ d., per 1000 feet,—the former much too high, and the latter too low, being, in fact, one-fourth of the low estimate which Mr. Croll gives as his cost by the combination of clay and iron.

Many other statements might be added to this, in which clay retorts are spoken of as perfect salamanders, showing no sign of decay after three or four years' use.

I will be content with the foregoing sample, and pass on to a statement which I have received from a gentleman quite disinterested in the success of either plan, and upon whose impartiality I have the greatest reliance.

The works alluded to had, during the three years ending 1847, 54 iron retorts, 25 of which were burnt out annually, at an expense of £241 14s. 7d.; the gas manufactured being about 17,000,000. That is at the rate of 3·41d., or nearly $3\frac{1}{2}$ d., per 1000 feet; this, however, is without furnace-doors and fire-bars. Since this time the conductors of the works have arranged with a clay retort maker, who is well acquainted with his business, as well as a good gas engineer, to supply and keep in repair clay retorts sufficient to make the same quantity of gas, still excepting furnace-doors and bars, for a

series of years, at £160 per annum, or at 2·26d. per 1000 feet. The price by this statement will be in cost,

Iron, ... 3·41d.
Clay, ... 2·26d.

Difference in favor of clay, . 1·15d.

THE BRITISH AND NORTH AMERICAN
ROYAL MAIL STEAM NAVIGATION COM-
PANY'S NEW STEAM VESSEL "AFRICA."

Built by Messrs. Robert Steele & Co., Greenock,
1851. Engines, &c., by Mr. Robert Napier, Glas-
gow.

	British.		American.	
Old measurement.	Ft.	In.	Ft.	In.
Length aloft	267	0	267	0
Ditto, keel and fore rake	267	0	267	0
Breadth of beam . .	40	6	40	6
Do. over paddle-boxes	63	6	63	6
Depth of hold	27	6	20	3
Length of engine-space	92	3	92	3
Tonnage.	Tons.		Tons.	
Hull	2128		2106	
Contents of Engine-space	811		800	
Register	1316		1305.	

	British Act for foreign vessels.			
New measurement.	Ft.	Tns.	Ft.	Tns.
Length on deck	265	2	265	2
Breadth on do., amidship	37	6	37	6
Depth of hold on ditto	27	2	27	2
Length of engine-space	92	3	92	3
Tonnage.	Tons.		Tons.	
Hull	2226		2067	
Contents of engine-space	1010		1010	
Register	1216		1057	

By the loaded act this vessel is 748 tons less than the *Pacific*. A pair of side lever engines of 814 horses nominal power; diameter of cylinder, 96 inches $\times$ 9 feet length of stroke; paddle-wheels, diameter extreme, 37 feet 7 1-2 inches, and 36 feet 10 1-2 inches effective; 28 floats, 9 feet 2 inches $\times$ 3 feet 2 inches; three sets of 28 arms; 8 floats in water, at a mean draft of 19 feet 3 inches.

Four flue boilers, with return flues at the back of boiler; length 20 feet; breadth, 16 feet; height, 12 feet; with a large steam chest; 20 furnaces, 5 in each boiler, length, fire bars, 8 feet; breadth, 2 feet 9 inches; height, 7 feet; passage between boilers, 2 feet wide; boiler to bunkers, 7 feet 7 inches; bunkers hold 890 tons of coals; draught of water,

(mean), with engines, boiler, &c., 15 feet; carries 1,842·9 tons of cargo.

ROBINSON'S AND RUSSELL'S PATENT METH-
OD OF ARMING STEAMERS.

Messrs. Robinson and Russell, the eminent engineers, have lately built two war steamers of peculiar construction, for the Prussian government.

The improvements, which they have patented, consist in the mode of arming paddle-wheel steamers, by enabling them to carry four large pivot slide guns, on strongly constructed sponsons, one on each side of the paddle-box, and, consequently, near the centre of the vessel. The guns are so arranged, that they can be fired inclined towards, as well as parallel to, the line of the vessel's keel, with great facility. In practice, the *Salamander* fired her 8 in. guns at an angle which crossed her bow at 350 yards distance. Such vessels are thus enabled to engage end on with most effect, presenting a comparatively small and not easily vulnerable mark to an enemy. The wings, or sponsons, are constructed upon a plan which offers the least obstruction in a heavy sea, and the sides of the vessel are stiffened internally, and rendered free from vibration, by a series of vertical tie plates. The vessels are constructed with a rudder at either end, and both ends being perfectly similar, are enabled to engage from bow and stern simultaneously, and retreat in either direction without being obliged to turn round, and, consequently, without presenting her broadside to the enemy.

The iron steamers *Salamander* and *Nix* are each 186 feet in length, extreme, 26 feet beam, and 11' 6" deep, = 560 tons burden; with engines of 160 horse power; cylinder 48 inches diameter and 4 feet 6 inches stroke. When fully equipped, with armament, ammunition, stores, and coals, the draft of water is only 6 feet 9 inches.

An important point attained by this improvement is in the vessel carrying all her heavy weights and guns at or near the centre, thereby possessing the qualities of a safe and easy sea boat.

These vessels are divided into 13 compartments, by 12 watertight bulkheads; they have two sets of boilers, one before and one abaft the engine room, in sep-

arate compartments, and surrounded by four feet thickness of coal in the bunkers, which form also water-tight compartments longitudinally in the vessel; they are also lined throughout with eight inches thickness of teak.

The framing of the engines is peculiar, being constructed on the plan first introduced by Messrs. Robinsons in the *Manchester*, and in being entirely of wrought iron, passing completely round the sides and bottom of the vessel, to which it is riveted; thus adding a combination of great strength to both hull and engines.

The speed of the vessel on an average of 6 runs at the measured mile was 13 1-4 knots per hour, the engines making 36 to 38 revolutions per minute.

We hope in our next number to give drawings of some of the details, which possess especial interest at a time when iron vessels of war have been so hastily condemned.

PAPERS READ BEFORE THE INSTITUTION
OF CIVIL ENGINEERS.

February 25, 1851.—"A Description of the 'Royal Border Bridge,' erected over the river Tweed, on the line of the York, Newcastle, and Berwick Railway," by Mr. G. B. Bruce, M. Inst. C. E.

This viaduct, the total length of which was 2160 feet, and the extreme height 129 feet, consisting of 28 semi-circular arches, each 61 feet 6 inches span; and the whole constructed of stone, with the exception of the inner part of the arches, which was of brick, laid in cement. It was divided into two parts by a central abutment, which enabled the land arches to be completed, and, along with a temporary timber bridge, to be brought into use for public traffic, before the completion of the river arches, which necessarily occupied a considerable period in execution, owing partly to very substantial coffer-dams having been requisite for the river piers, but principally to its having been thought advisable to pile the foundations of most of those piers, as the bed of the river was liable to be scoured away by the rapid stream. The piles, both of the coffer-dams and of the foundations, were mostly of American elm, as it was found that the heads of the Memel piles required to be frequently cut off and re-hooped, when driven by Nasmyth's steam pile-

driver, which was almost entirely used, both on account of expedition and of economy; for it was proved, that whilst the hand ram only gave one blow in four minutes, the steam pile-driver gave sixty blows in one minute, and that the cost of the former was two shillings per lineal foot, whereas that of the latter was very little more than one shilling per lineal foot. It was also remarked, that the force was more advantageously employed in the case of the steam pile-driver, as, on account of the ram being heavier and the fall less, the piles were not so frequently split.

The piers had an ashlar facing, and were filled in with well grouted rubble, having occasional through courses of ashlar, and an ashlar tie in the centre of their width from top to bottom. Great care was taken in the preparation of the mortar and the grout, used in this work, and after a variety of experiments, the plan finally adopted was,—in the case of setting lime for ashlar,—to grind quicklime dry by itself, in a common mill, and then to mix it with coarse sharp sand, screened out of gravel taken from the bed of the river, in the proportion of three of sand to one of quicklime; this was then put under cover until required. Lime to be used for grout was also ground dry, and along with it was ground slag from an iron furnace, then gravel from the river was mixed with it without being screened, the proportions being quicklime one, slag three quarters, and gravel two and a quarter. The mortar when used had absorbed a sufficient quantity of moisture from the atmosphere and the sand to prevent its being too hot for use, and yet, as it had not been previously mixed with water, and wrought into a paste, it retained its original setting power. This mortar required to be used very soft, and the stones to be well wetted, and, as the sand was very coarse, thick joints was necessary, but in a few weeks it set as hard as Roman cement. All the lime used in this work was from the mountain limestone of the Scremerston and Lowich districts of Northumberland.

The centres which were stated to have been of peculiar construction, were supported entirely from the piers, so as to prevent any accident happening, if the scaffolding was injured, either by the heavy floods of ice to which the river

Tweed is subject in winter, or from the vibration caused by passing trains; as when the idea was first entertained of having a temporary bridge, the intention was merely to add to the contractors' scaffolding, and to make it serve for both purposes. This intention was, however, abandoned, and an entirely separate timber bridge was erected, on the east side of the stone bridge, at a cost of 14,340*l*.

The total cost of the "Royal Border Bridge" was 120,000*l*., and of the whole contract, one mile in length, in which it was comprised, 207,000*l*., including an embankment, which had to be made entirely from side cutting, and which contained, probably 760,000 cubic yards.

Some valuable and interesting experiments and observations were given on the velocity and regimen of the river Tweed, and the results compared with the theories generally laid down relative to running waters, by Buat and Eytelwein; and it appeared, that although both approximated closely to actual experiment, Buat's formula gave the best result.

March 4, 1851.—In the renewed discussion upon Mr. Bruce's Paper, descriptive of the 'Royal Border Bridge,' at Berwick, the question was raised as to the propriety of using ashlar and rubble, in combination, for works of this nature. Some of the speakers considered, that it was preferable to use either the one or the other alone, to prevent unequal settlement, from the different character of the two kinds of work; and instances were cited of the piers of large viaducts having been entirely constructed of rubble, with the most perfect success. On the other hand, it was urged, that if in quarrying stone those blocks only were used which were suitable for ashlar work, much waste would arise, and great extra expense be incurred; also that in the piers of the "Royal Border Bridge," the back of the casing of ashlar was vertical, so that although externally the piers had offsets, the internal face of the ashlar did not follow that line, and therefore none of the weight which the ashlar ought to bear was brought upon the rubble. It was thought that good rubble, formed of large flat-bedded stones, well bonded, and set in good mortar, was preferable for dock walls, or in other situations where a head of water had to be supported, or lateral pressure sustained, but that ashlar

was better adapted for bearing vertical pressure, or weight, as in the piers of a viaduct.

REVIEWS.

Annual Report of the State Engineer and Surveyor on the Canals of the State of New-York. Feb. 6th, 1851.

THIS is a valuable document, and embodies much information in detail of the progress and condition of the State Canals; but aside from this it will be read with interest for the sound and enlarged views entertained by our State Engineer, H. C. Seymour, Esq., on the policy of the immediate enlargement of the Erie Canal. In sustaining his position, some railroad statistics are introduced as bearing upon the question, which in themselves are highly interesting, and will well repay a study. Did space permit, we should extract from this part of the Report, but must limit ourselves to the note intended to show more clearly the immensity of the canal business in New-York by supposing it transferred to a railroad.

"The tons arriving at tide water last year, were 2,033,86*g*; all performed in the space of 226 days. A railroad, operated six days in the week, will have 313 working days in a year. If the above business should be divided equally throughout the year, then the arrival at tide water would be 6,498 tons daily; average loads of 100 tons of freight per train, would require the arrival daily of 65 trains; equal to one train *every twenty-two minutes throughout the twenty-four hours!* A railroad performing a large passenger and fast freight business, and having a double track with usual turn-outs, could not, I suppose, perform one-sixth of the above, as *additional business*, by slow trains, even admitting that the variations of trade at different seasons of the year could, by increased loads, be accommodated by the number of trains stated. In other words, it would require six double-track railroads, having other traffic from which to earn dividends, to perform the business of the Erie Canal during the past year, and some eight or ten for the business which the enlargement can command. The above business would require an outfit of at least 10,000 cars and 400 engines, costing say \$9,000,000; and if confined to one road,

would require the daily arrival of 4½ miles of trains to be unloaded, loaded, and sent back, supposing that each train and *each car* should be fully loaded.

"All the railroads now built and in *process of construction*, to connect Baltimore, Philadelphia, New-York, and Boston, with the West, would be overburdened with business, if freights equal in amount to that of the Erie Canal should be thrown upon them."

The cost of transport by canal being only 1½ cents per ton per mile, is what the Engineer has reference to when he uses the expression, "having other traffic from which to earn dividends."

De Bow's Review. Monthly. New Orleans. \$5 per annum.

THE articles in this Review are well selected, and on all that relates to the commerce, agriculture, manufacture, improvements, &c., of the South, it may be consulted with profit. The last three numbers contain a valuable article on Sugar Manufacture; and as devoted to the interests of the South generally, it evinces a spirit which merits success.

The following notice of the Editor we commend to all whom it may concern as an appeal unanswerable in words.

"Gentlemen of the South, we expect you to stand by us in this enterprise, for otherwise, like Sir John, in the play, we should show 'a wonderful alacrity in sinking.'"

PATENTS.

List of Patents (with claims annexed), which issued from the United States Patent Office from the 25th day of March, 1851, to the 8th April, 1851, both inclusive.

7994. *For Improvement in Adjustable Land-Sides of Plows.*—GEO. HEFFLEY, SAM'L. CONRAD, and JAMES WIGLE, of Berlin, Pa. Dated March 25. "The nature of our improvements in the plow consists in the arrangement, combination, and use of a separate adjustable heel and rest, attached to the land-bar, for the purpose of regulating and governing the depth of the furrow at pleasure, with great ease and exactness. Also, in extending the mould-board on the inside back,

to form a flange or support upon the reversible bar-point, and to which they are secured. Likewise, in forming, upon the two sides of the reversible bar-point, transverse long and short notches, into which fit corresponding long and short projections or locks, formed on the upper side of the land-side and underside of the flange or extension of the mould-board, for the purpose of securing the reversible bar-point."

7995. *For Apparatus for securing Shutters in any required position.*—CHARLES W. KREBS, of Baltimore, Md. Dated March 25.

7996. *For Improved Sash-Lock.*—MICHAEL NORTON, of Cambridge, Mass. Dated March 25.

7997. *For Improvement in Extension Tables.*—LEWIS THORN, of Philadelphia, Pa. Dated March 25.

7998. *For Apparatus for Moving and Securing Shutters, &c.*—N. W. SPEERS, of Cincinnati, O. Dated March 25. Claim—"The manner of opening and closing window shutters from the inside, and securing them firmly at any point in their semi-circuit."

7999. *For Improved Apparatus for Drawing and Measuring Liquids.*—RICHARD F. STEVENS, of Syracuse, N.Y. Dated March 25. Claim—"The combination of measures with faucets, cocks, or gates, in drawing liquids."

8000. *For Improvement in Scythe Fastenings.*—NATHANIEL LAMSON, of Shelburne Falls, Mass. Dated March 25.

8001. *For Improvement in Machine for Preparing Clay for making Brick.*—HERMAN WHIPPLE, of Port Richmond, N.Y. Dated March 25. [Plan and detailed specification in next No. of Mag.]

8002. *For Improvement in Upright Piano-Fortes.*—HENRY KLEPPER, of Cincinnati, O. Dated March 25. Claim—"The arrangement of the sounding-board in upright pianos, between the strings and the performer."

8003. *For Improvement in Scythe Fastenings.*—NATHANIEL LAMSON, of Shelburne Falls, Mass. Dated March 25.

8004. *For Improvement in Balanced Valves.*—FRANCIS B. STEVENS, of New-York, N.Y. Dated March 25. [Plan and specification in detail in next No. of Mag.]

8005. *For Improvement in Machines for Folding and Measuring Cloth.*—HENRY BOOT, of New Bedford, Mass. Dated April 1. Claim—"1st, Folding the cloth as it passes through or between the calender rollers, during the process of calendering, or by passing it through or between a pair of revolving rollers, similar to calender rollers, the said calender or other rollers being hung in a carriage, which receives a reciprocating motion above or across a table, and a tilting motion at each end of its stroke, so as to bring each roller alternately to bear on the table, as it (the carriage) moves in different directions across it, thereby laying the cloth under the rollers on the table, in folds or layers. 2d, Making the reciprocating motion of the ca-

lender rollers of a certain fixed length, such length determining the length of the fold, and thereby measuring the cloth."

8006. *For Improved Horse-Shoe Nail-Machine.*—MARSHALL BURNETT, of Boston, Mass. Dated April 1. Claim—"Making a horse-shoe nail, by means of a stationary former and a series of traveling and rotating cans."

8007. *For Improved Machine for Sticking Pins on paper.*—CHAUNCEY O. CROSBY, of New Haven, Conn. Dated April 1. Claim—"The conical form of rollers, to constitute my feeding channel for arranging the pins and moving them forward in the channel with the most suitably decreasing rates of descending velocity. Second claim—the combination of the parts and the adaptation of my machine for feeding the pins, separating and delivering them, crimping the fillet, and sticking the pins crosswise of such fillet, and finally, rolling the fillet into a coil. Also the screw separator as described, placed in the feeding channel, to restrain the natural descent of the column of pins, so that they may be delivered as fast, and no faster, than they are required for sticking."

8008. *For Improvement in Wheat Fans.*—JEHU HOLLINGSWORTH, of Zanesville, Ohio. Dated April 1. Claim—"Two or more chambers and areas, in combination with a fan, for the purpose of cleaning and separating grain, by using one and the same blast—to clean it) over and over again, any number of times."

8009. *For Improvement in Mills for grinding Paints and Drugs.*—GILBERT D. JONES, of Jersey City, N. J. Dated April 1. Claim—"The construction of a mill, in which the grinding surfaces shall consist of a plane, or planes, operating upon a cone. Also, the lever in combination with the muller for the purpose of regulating the feed."

8010. *For Improvement in Rice Hullers.*—PETER McKINLAY, of Charleston, S. C. Dated April 1. Claim—"Operating the pestle by having it attached to a rod passing through the bottom of the mortar and receiving motion through a crank, or its equivalent, placed below it."

8011. *For Improvement in Blasting Rocks, &c.*—CHARLES MONSON, of New Haven, Conn. Dated April 1. "My invention consists mainly in confining the charge or blast, between opposite projections or flanges, plates or portions of iron or other suitable material, firmly connected together, by means of which, the force of the blast, in the direction of said opposite plates or projections, is divided against itself, and so restrained as to act with greatly increased effect in other directions in which it is required."

8012. *For Improved Machine for forming a Lock on sheet metal.*—JABEZ WALKER, of East Bloomfield, N. Y. Dated April 1.

8013. *For Improvement in Wheat Fans.*—JESSE WHITE, of Barnesville, Ohio. Dated April 1. Claim—"The combination of the fan, hair trunk, and head."

8014. *For Improvement in Bran Dusters.*—JOHN M. CAHR and JAMES HUGHES, of Cambridge City, Ind. Dated April 1. Claim—"The combination of the openings, both provided with valves or registers, with the runner and fan revolving within an upright cylindrical casing, the upper part of which acts as a beater, and the lower part as a bolting apparatus, for the purpose of separating the flour which adheres to the bran, after undergoing the ordinary bolting; the said process being regulated and adjusted to suit the circumstances of weather, &c., by admitting more or less air, either above or below, by means of the registers."

8015. *For Improvement in connecting and disconnecting Wheels and Axles.*—SIMEON HEYWOOD, of Claremont, N. H. Dated April 1.

8016. *For Improvement in the manufacture of India Rubber.*—DAVID M. CURDY, of Newark, N. J. Dated April 1. [Specification in detail in next No. of Mag.]

8017. *For Improvements in Splint Machines.*—HENRY MELLISH, of Walpole, N. H. Dated April 1.

8018. *For Improvement in Seed Planters.*—ARCHIBALD WIETING, of Middletown, Pa. Dated April 1. Claim—"Placing two or more hollow drill teeth in a direct line, one behind the other, managed and drawn by the same drag bar; the front tooth being made the longest, and so placed as to run somewhat deeper in the soil than its successor or follower, for the purpose of depositing fine manure, or chemical agents, beneath the grain, when planted in rows or otherwise."

8019. *For Improvement in Machines for cutting Screws on Bedstead Rails.*—H. GROSS and W. CAMPBELL, of Tiffin City, Ohio. Dated April 1. Claim—"Arrangement by which the instrument, during the operation of cutting, is forced firmly against the head, the strain upon the confining screw being thereby greatly reduced, and the cutting tool itself strengthened."

8020. *For Stone and Metal Conglomerate for Paving, &c.*—GEORGE H. KNIGHT, of Cincinnati, Ohio. Dated April 1. "The nature of my invention consists in the formation of a conglomerate block, composed of stone and iron, by pouring the molten metal around and among broken stone, within a mould, the metal forming a bond of union by which the stone is held together in one coherent mass, and so distributed among the metal as to present a nearly uniform mixture of the two materials, in such proportion as may be desired."

8021. *For Improvement in Brick Presses.*—JOHN I. RIDDLE, of Covington, Ky. Dated April 1. [Plan and specification in detail, in next number of the Magazine.]

8022. *For Improvement in Sawing Machines.*—PEARSON CROSBY, of Fredonia, N. Y. Dated April 8. "The nature of my invention consists in making a circular saw,

with both faces convex, or swelled so that it shall present a thin edge where the teeth are cut, to avoid waste of the lumber, and reduce the resistance in cutting, and be gradually thicker towards the shaft to give it the requisite thickness to prevent buckling and insure a steady motion at the periphery; when this is combined with a fixed bevelled gauge, placed near the periphery of the saw, on that side of the shaft opposite to where the lumber is presented to the teeth, so that the said gauge shall separate or spread the two parts of the plank as they are being cut, and prevent them from binding against the faces of the saw."

8023. *For Improvement in fastening down Table Leaves.*—LEWIS J. MASON, of Franklinville, N. Y. Dated April 8.

8024. *For Improvement in Brick Presses.*—J. Z. A. WAGNER, of Philadelphia, Pa. Dated April 8. "The nature of my invention consists in a large wheel of cast iron, or other suitable metal, hung on a shaft in suitable bearings, and having its periphery of cylindrical form, and having recesses therein of the required form and size of the bricks, at any convenient distance apart all around it; these recesses form the moulds, the bottoms of which are formed of loose plates, having shanks attached to their inner sides, passing through guides in the wheel, the said shanks having spindles passing through and secured in their ends, and carrying friction rollers; two pressure rollers, having their peripheries of the same width as that of the mould wheel, are hung in suitable bearings, so that their peripheries are in contact with that of the mould wheel; the first or larger of the pressure rollers has a slight recess all around its periphery, of the width of the moulds, and the second or smaller, or pressure roller, is cylindrical. A hopper is placed above the mould wheel and first pressure roller, and as the mould wheel rotates, the clay is drawn into the moulds and pressed in by the first pressure roller, which leaves some clay remaining above the moulds to be pressed in by the second pressure roller, which finishes the brick; the bottom of each mould is forced outward in a manner similar to the action of a piston, by the friction rollers attached to it, passing over a stationary eccentric way until it is flush with the periphery of the wheel, when the brick is picked off by a picker and falls on an endless belt or apron, which carries it away."

List of English Patents issued from Jan. 28, 1851, to Feb. 18, 1851.

Joseph Crossley, of Halifax, for improvements in the manufacture of carpets, rugs, and other fabrics. January, 28; six months.

Samuel Morand, of Manchester, for improvements in apparatus used when stretching and drying fabrics. January 30; six months.

Bennet Woodcroft, of Fumival's Inn, for improvements in Machinery for propelling. January 30; six months.

James Murdoch, of Staple-inn, Middlesex, for certain improvements in preserving animal and veget-

able substances. (Being a communication.) January 30; six months.

Charles Gouthelf Kurd, of Paris, France, engineer, and Charles Alexis de Wendle, iron master, also of Paris, for improvements in the process and instruments to be used for boring the earth, and sinking shafts of any given diameter, for mining and other purposes, and in the means of lining such shafts. January 30; six months.

Albert Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman, for improvements in manufacturing looped and other woven fabrics. (Being a communication.) January 30; six months.

Richard Johnson, of Manchester, wire-drawer, for certain improvements in annealing articles of iron and other materials. January 31; six months.

Juan Neponniceno Adorno, of Golden-square, Middlesex, gentleman, for improvements in the construction of maps and globes, and in apparatus for mounting the same. January 31; six months.

Charles Marsden, of Kingsland-road, Middlesex, engineer, for certain improvements in boots and shoes. January 31; six months.

George Bradshaw, of Bishopsgate-street Within, London, hosier, for certain improvements in fastenings for garments. January 31; six months.

Jean Paul Gage, of Paris, France, chemist, for improved chemical compounds for tissue bandages, wafers, and also for surgical purposes. January 31; six months.

David Davies, of Wigmore-street, Cavendish-square, Middlesex, coach maker, for certain improvements in the construction of wheel carriages and in appendages thereto. January 31; six months.

John Davie Morris Stirling, of Black Grange, North Britain, Esq., for improvements in the manufacture of metallic sheets, and coating metals, in metallic compounds, and in welding. January 31; six months.

Samuel Allen, junior, of Birmingham, manufacturer, for certain improvements in the manufacture of buttons. February 1; six months.

Nathaniel Jones Amies, of Manchester, manufacturer, for certain improvements in the manufacture of braid, and in the machinery or apparatus connected therewith. February 1; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improvements in communicating intelligence by electricity. (Being a communication.) February 3; six months.

Alexander Alliot, of Lenton Works, Nottingham, engineer, for improvements in cleaning, dyeing, and drying machines, and in machinery to be used in sugar, soap, metal, and color manufacturing. February 3; six months.

Benjamin Ledger Shaw, of Huddersfield, for improvements in cleaning and preparing wool and other fibrous or textile materials, and in the manufacture of colored yarns of wool and other fibres, and in weaving. February 5; six months.

Angier March Perkins, of Frances-street, Regent-square, Middlesex, engineer, for improvements in railway axles and boxes. February 5; six months.

Charles De Bergue, of Arthur-street West, London, engineer, for improvements in and in the construction of the permanent way of railways. February 7; six months.

Frederick R. Robinson, of Bolton, Massachusetts, United States of North America, for a new and useful sewing machine. February 7; six months.

William Onions, of Southwark, Surrey, engineer, for improvements in the manufacture of certain parts of machinery used in spinning. February 7; six months.

William Onions, of Southwark, Surrey, engineer, for certain improvements in the manufacture of steel. February 7; six months.

François Marcellin Aristede Dumant, of Paris, engineer, for improved means and electric apparatus for transmitting intelligence. February 7; six months.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in apparatus for milking animals. February 10; six months.

Peter Fairbairn, of Leeds, machinist, and John

Hetherington, of Manchester, machinist, for certain improvements in mouldings for casting pipes, railings, gates, agricultural implements, and other metal articles; and also in preparing patterns or models for the same. February 10; six months.

Richard Stuart Norris, of Warrington, Lancaster, civil engineer, for certain improvements in the construction of the permanent way of railways, bridges, locks, and other erections wholly or in part constructed of metal; also improvements in breaks for railway carriages. February 10; six months.

John Stephens, of the Allyards, Astley Abbots, Salop, gentleman, for certain improvements in threshing machinery. February 10; six months.

Joseph Haythorne Reed, late of the 17th Lancers, of the Harrow-road, gentleman, for improvements in saddlery and harness. February 10; six months.

John Harcourt Brown, of Fir-cottage, Putney, Surrey, gentleman, for certain improvements in the construction and building of ships, boats, buoys, rafts, and other vessels, and appliances for preserving life and property at sea. February 10; six months.

Charles Xavier Thomas (de Colmar), Chevalier de la Legion d'Honneur, of Paris, France, for an improved calculating machine, which he calls "Arithmometer." February 10; six months.

William Weild, of Manchester, engineer, for improvements in machinery for turning and burnishing. February 11; six months.

Benjamin Heywood, of Water-street, Manchester, coach-builder, for certain improvements in railway and other carriages. February 11; six months.

George Briand, of Nicholas-lane, London, surveyor, and Richard Fell, of the City-road, engineer, for certain improvements in obtaining fresh and pure water from salt sea, and other waters. February 11; six months.

Charles Howland, of New York, America, engineer, for improvements in bell telegraphs. (Being a communication.) February 11; six months.

Angier March Perkins, of Francis-street, Regent-square, Middlesex, for improvements in constructing and heating ovens. February 11; six months.

James Webster, of Leicester, engineer, for improvements in the construction and means of applying carriage and certain other springs. February 11; six months.

Edwin Ullmer, of the firm of Edwin and William Ullmer, of Fetter-lane, London, printing-press makers, for certain improvements in printing presses. February 12; six months.

Charles William Tupper, of Oxford-terrace, Middlesex, gentleman, and Alphonse Rene le Mere de Normandy, of Dalston, in the same county, gentleman, for improvements in the manufacture of iron coated with other metal, commonly called galvanised iron. February 12; six months.

Charles Cowper, of 20, Southampton-buildings, Chancery-lane, for improvements in moulds for electro-metallurgy. February 17; six months.

Henry Francois Marie de Pons, of 24, Boulevard Poissonniere, Paris, France, gentleman, for improvements in constructing roads and ways, and pavements of streets, and the ballast of railways. February 17; six months.

Gustav Adolph Buchholz, of Norfolk-street Strand, Middlesex, civil engineer, for improvements in motive power and in propulsion. February 17; six months.

David Ferdinand Masirata, of Golden-square, Regent-street, Middlesex, gentleman, for a new mechanical system with compressed air adapted to obtain a new moving power. Feb. 18; six months.

Thomas Dickason Rotch, of Furnival's-inn, gentleman, for improvements in centrifugal apparatus for separating fluid from other matters. February 18; six months.

William Beadon, junior, of Taunton, Somerset, gentleman, for improvements applicable to the roofing of houses, buildings, and other structures. February 18; six months.

Hugh Lee Pattinson, of Scots-house, Gateshead, manufacturing chemist, for improvements in the manufacture of Pattinson's oxichloride of lead. February 18; six months.

CORRESPONDENCE.

We extract from the last letter of our Correspondent in England. His views on mechanical matters will be found worthy of notice, being himself a thorough-bred mechanic.—Speaking of the objects of interest to American mechanics, which will be on exhibition at the Crystal Palace—he says:

Among others, the cotton machinery of Messrs. Hibbert, Platt & Co., of Rochdale, now used in many of the newest and finest mills in England, where we find the old system of 'top-flats' on the cards thrown by, and 'workers and strippers,' such as are used for wool with us, introduced for all nos. of yarn coarser than 80, a limit which will cover 999 per cent of all the yarn made in America. Then we shall find from Messrs. Wm. Higgins & Sons of Salford, Manchester, the very latest improvements in working flax, a branch of manufactures which should have been taken up before now* in America, considering the tons which are annually raised in New-York and Ohio for seed alone. Messrs. Taylor and Wordsworth, of Leeds, will send the latest machinery for combing worsteds, and Messrs. E. B. Wilson & Co. of the same place, a model for a locomotive engine, for branch lines, being a combination of engine and tender, in about the room of an ordinary engine. I hope to send you a sketch of it soon, and can only say that I had the pleasure of a ride of 13 miles behind it yesterday, in which it performed its duty to admiration. On this point of locomotives, however, we are much farther in advance in America than 'John Bull' gives us credit for, and I should like to see a twenty-ton American locomotive, with 4 drivers, such as are now being turned out at the Essex machine shop at Lawrence, the Amoskeag shop at Manchester, N.H., or by Hinkley and Drury at South Boston, on exhibition here this season, for English engineers think that all our engines are like those built by 'Norris, of Philadelphia,' some time since, for the Birmingham and Gloucester R.R. No one thing has damaged our credit for decent and durable machinery so much as those engines, and it is almost impossible to make an Englishman who has not been in America, believe that we can do any thing better.

An American Engine, such as I before mentioned, is a very much handsomer affair than any English engine I have seen, and would do us great credit could one appear in Hyde Park next summer. Is it yet too late to send one over? Much attention will be paid to American contributions, and I trust there will be nothing sent over to disgrace us by its *fimsiness*.

I shall be able to send you many items from the exhibition, and will defer further mention of it for a future letter.

Much attention is now being paid here to steam boilers, and economy of producing steam; and there are two forms of boiler which are at present the favorites in Lancashire and Yorkshire. The one which I shall call the 'Yorkshire boiler' is as follows—say 6 or 8 feet in diameter, and 30 feet long, on an average, with two flues of 20 inches, or 2 feet in diameter, and a grate in the front of each flue, say 3 feet deep, in some cases 4 feet. The boiler is set in brick to half its height, and well covered with clay, ashes, &c., to prevent the escape of heat. The other boiler, which I will call the Lancashire boiler, is about the same diameter, but has only one fire-grate, which goes back say nearly half the length of the boiler, or about 8 feet in a 20 feet boiler; the back half of the boiler below the same line is then filled with pipes like a locomotive boiler.

Both these plans appear to give very good results with bituminous coal, but I do not like the angles at the meeting of the flue, with the shell-shaped places I have marked as *a*, *a'*, in the Lancashire boiler. I think they will very soon fill with scale and be very bad to clean.

I doubt much if any better form for boilers for Anthracite coal, has yet been discovered than the one described in Appleton's Dictionary as the plan in use at the Lowell Company's Works, in Lowell. The

truth is, that coal is so cheap in England, that less attention has been paid to economy generally, than with us in America.

Coal is delivered at most of the mills in all this district, at prices varying from 87½ cents to \$1 37½ cents per ton, and consequently, steam and gas are very cheap. One of my friends here estimates his gas to cost him about 93 cents per M. cubic feet. More attention has been paid to economy of labor, and speed of machinery, in many points, than with us; and I have seen looms running here at a speed of 180 picks per minute, a point on which I will write you more in detail in another letter.

One great difficulty which an American experiences in this part of the country, is the total want of uniformity of system in the different manufactories. Each man 'does as he sees best in his own eyes,' and one who has been about the country as I have, finds himself more puzzled every day to arrive at an average result. Take the point of wages; here in Bradford, where I am writing to-day, girls will earn from \$2 50 to \$4 00 per week—go to Wales, and you will find girls at work in the Iron Furnaces, shovelling coal, and piling iron, for \$1 20 per week! You cannot find that difference in the value of labor between Providence R. I., and Patterson, N. J.

The 'flax discovery,' or the new mode of working flax by cotton machinery, has been exploded, and to that subject, and the improvements in cotton machinery, I propose to direct my next letter.

NEW-YORK ASSOCIATION OF ENGINEERS AND MECHANICS.—Will the Secretary be pleased to forward the names of the officers of this institution for the present year?

"D. A. S.," *Charlestown, Mass.*—If he had been a constant reader of the Magazine, as he professes to have been, he would have been saved the expense of buying a work on Railroad calculations, to which he refers as failing to meet his wants.

In the present number will be found a formula for calculating excavations and embankment, introduced, not that we conceive our engineers to need such assistance, but as a specimen of the labors of a self-taught young engineer who is laboring in the west, cut off from all the sources of information with which we are surrounded.

Our own practice has been *not* to use a general formula for estimating excavations, save in rapid estimating for experimental lines. But for the final estimate, and estimates made for construction, to suppose the solid cut up into its elementary figures of wedges, pyramids, prisms, &c., and estimating the content of each. This method is the only reliable one for accuracy—the approximation to the truth is nearer by this than by any other method.

"S. S.," *Civil Engineer, Cambridge, Mass.*—His communication in reference to the Whistler Monument has the appearance of having been intended for publication, but we fear the writer has made a mistake in the address. The communication will much better suit the columns of the Herald than our own.

The article is very funny—was intended to be so, doubtless; but even at the risk of depriving our readers of some harmless amusement, we must beg leave to decline its publication. "S. S." will under-

stand us when we say, that our respect for the *living*, exceeds his for the *dead*.

One word in reference to the Monument, and in answer to such as apply to S. S. for information respecting it—

At a large meeting of Engineers, held in this city, more than a year since, it was decided that some expression on the part of the profession, of the respect in which they held the memory of the late Major Whistler, was due as well to themselves as to him. Accordingly officers were chosen to solicit subscriptions from the professional friends of the late Major Whistler, with a view to the erection of a monument to his memory in Greenwood Cemetery.

Circulars were sent to all who were supposed to feel an interest in the matter; and what was the response?—We blush to name it.—"S. S." speaks of "the love and respect borne him"—of his "friends throughout the country eager to express in any tangible way their estimation of his talents." We can tell him, that of the miserable pittance collected for the above mentioned sacred purpose, not one fifth was subscribed by his professional friends; and more than this, many in highly prosperous circumstances, who owe every thing they possess in the world to him, and but for his kindness would in all probability have remained in the obscurity in which they were born, could not find one dollar for a monument to the man who raised them from the mud to a place among gentlemen; and who did more to elevate the character of the profession (save in this mistaken kindness to *them*) than they are capable of appreciating.

The Treasurer of the Society is Mr. C. M. Dexter, of Boston. The site for the Monument in Greenwood Cemetery has been selected. And as one of the committee for selecting a plan, and building the monument, we are ready to do our part so soon as the funds collected are worthy of the object.

LANDSCAPE GARDENING.—It seems that the roof of the great Crystal Palace leaks beyond hope of remedy, short of some huge umbrella for the whole affair. The principle of its construction is undoubtedly faulty as respects strength; that is to say, too great reliance is placed upon the square fittings of cast-iron with cast-iron, without the aid of diagonal bracing; and we should not be surprised to learn of a failure in some part of it during the heat of summer. The leaking is irremediable so long as glass and iron are affected by heat.

We would not lay a "wet blanket" over the affair, but we grieve to say that something as near like it as may be, will be found necessary before the building of the great Landscape Gardener will stand inspection.

In the description of the performance of the steamer *Reindeer*, on the Hudson, a few days since, the time table on the passage up, gave as the running time, 7 hours 35 minutes. Consumption of coal, 18 tons. Time down, against flood tide and wind, 7 hours and 43 minutes, distance 160 miles.

The writer makes a calculation, according to which he satisfies himself that her wheels had no slip—that is to say, she travelled over her wheels like a coach. Rather a remarkable steamboat!

MINOT'S ROCK LIGHTHOUSE.—In our February number will be found a drawing in elevation, and also a minute description of the iron-pile lighthouse built on the Minot's Rock, near Boston, which we now learn has been carried away in the late storm. The destruction was complete; not a vestige of the building remains; and the two keepers perished with the light.

This accident by no means diminishes our confidence in the material used, as applied to such structures.

It seems from appearances (the continued storm preventing as yet a minute examination), that the rock presents the appearance of having been split and torn off. This could not have been the case had the structure itself been too weak to withstand the violence of the sea. It was the presumed fact of the utter impossibility of the building vibrating to the extent asserted by the keeper (a foot or more), without inevitable and immediate destruction by fracturing the sockets of the piles, which led us to ascribe to the keepers' fears a statement inconsistent, in our view, with the fact that the building was then in existence.

The lighthouse *might* vibrate even to the extent asserted by the keepers, upon the supposition that a seam in the rock admitted of this motion; but it was *absolutely impossible that it could have done so in the framing*. If some of the broken pile heads should be found in their places, it would still be no evidence of the want of strength of the framing; for if the rock failed at any point, the bond of connection between the heads of the piles would be broken, and the destruction of the whole would follow as a matter of course—precisely as removing the key of an arch (though but a small part of the material upon which its strength depended) would most effectually destroy it.

Since writing the above, we learn from the papers that the heads of the piles appear broken off some three or four feet above the rock, all tending to the westward. Further and minute examination will be necessary before we can conclude that the framing was defective. We are still of the opinion that a seam in the rock permitted a movement of the base of the structure.—*April 20th.*

PAINÉ'S LIGHT.—Paine has at length patented his light in England, and we have before us the drawing of the machine, and his specification, together with his claim. Space in this number will permit but a brief notice of the subject, which, by the way, has attracted much attention abroad, and given rise to comments, we are sorry to say, of a character by no means flattering to some of our "savans."

Paine declines asserting that water is a simple substance, but contents himself with the assertion

that "one of the gases generated by discharging electricity through water will burn, and give a highly illuminating light." The secret of the rapid generation of the gas appears to be due, in addition to the hollow helices, to the discharges of electricity being by *pulses*, or intermittent.

We copy his claim:

First—The use of helices, in which are hollow helical coils, to be filled, at pleasure, either with water or other electrical absorbent.

Secondly—The use and construction of the electrodes, as above described. (Of platinum.)

Thirdly—The mode of applying electricity to the decomposition of fluids, by pulsations or intermittent discharges.

Fourthly—The construction and use of governors, for regulating the electric current, as described.

Fifthly—The method of catalyzing or rendering hydrogen gas luminiferous, by passing it through spirits of turpentine, or other hydrocarbon, at ordinary temperatures.

Sixthly—The use of non-conducting pipes, and isolated gasometers, for the purpose of conveying and holding the gases, for the purpose of this invention.

The drawings and specifications will appear in our next, when our friends may decide for themselves as to its merits. If it be a humbug, as we still think, it should take precedence of the moon hoax, as by far the boldest attempt of the kind on record.

A writer in the Builder asks the following in reference to the trees in the Crystal Palace:

"Now, sir, as to the trees, which the skilful contractor has capped over, allow me to ask of what use it is to let them stand, seeing that by June next the leaves, if they come out at all, will have completely withered. These veterans are too old to endure so violent a change of habit. They must perish from lack of moisture—no dew nor shower for the bud, the bark, or the root! Possibly they are left to record Mr. Paxton's triumph, possibly that of the popular voice, and they stand as trees of liberty. They are, however, monstrosities in the way, and can be of no value to either Exhibition or Winter Garden, since they never will (take my word for it) produce other than the crop they now bear—a crop of shavings!"

INDIA-RUBBER GAS-HOLDERS.—Mr. J. L. Hancock (London) has just completed four portable gas-holders, destined for the city of Mexico, which are in several respects worthy of notice. As no workmen are to be found in the capital of Montezuma capable of putting an ordinary sheet-iron gas-holder together, and as the cost of sending out competent men from this country for such a purpose would have amounted to a large sum, it was suggested that a substitute for iron might be found in canvas, rendered impermeable to gas by india-rubber, and Mr. Hancock's experience was called in to aid the carrying out of the suggestion. The vessels made by him are cylindrical bags, twelve feet diameter, and fifteen feet high, formed of a double thickness of strong canvas, stuck together with a solution of india-rubber. Rings of three-eighths of an inch round, iron, are introduced in the sides, at intervals of about a foot, so as to keep them in their circular shape, and the whole, when packed, represents a disc of twelve feet in diameter, by a few inches in thickness, in which form they are intended to be transported to their destination. The cost of each gas-holder, complete, is £55, or about 8d. for each cubic foot of its contents,—a sum considerably less than the cost of a tank and gas-holder of this dimension, and of the usual construction, in this country.—*Journal of Gas Lighting.*

APPLETONS'

Mechanics' Magazine and Engineers' Journal.

VOL. I.]

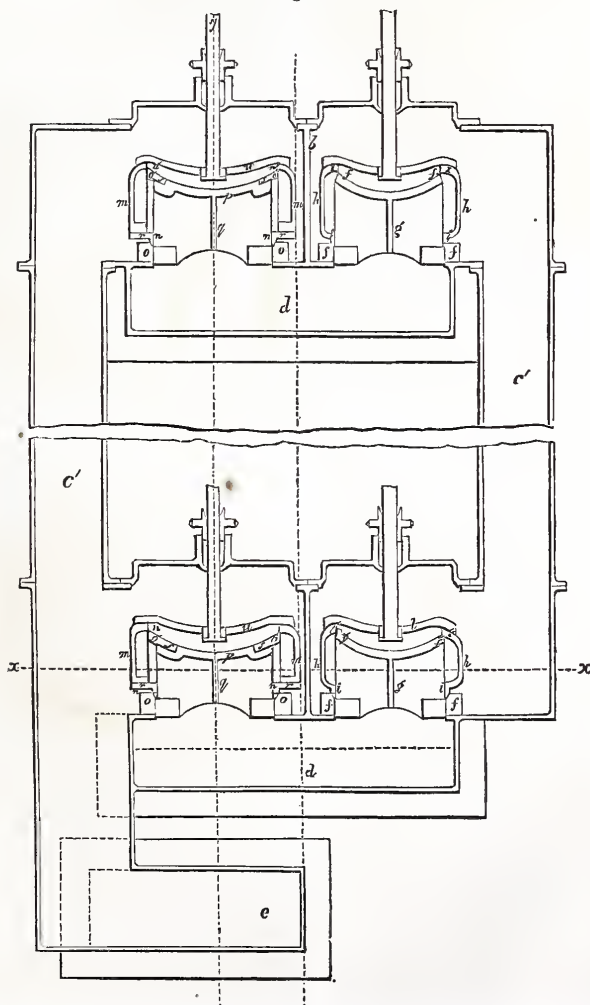
MONDAY, JUNE 2, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 6.]

STEVENS'S IMPROVEMENT IN BALANCED VALVES.

Fig. 4.



IMPROVEMENT IN BALANCED VALVES.

Francis B. Stevens, of New-York city. Dated March 25th, 1851.

My object is a convenient adaptation to the double acting steam engines of balanced valves, commonly known as the Cornish double beat valves. For the balanced spindle valve, as commonly constructed, are liable to two objections: in the first place, the valve being formed by two disks connected by a spindle, the force of the steam acting against the disks in opposite directions puts a great strain on the spindle, so that should it be slightly eccentric, the valve will be sprung from the seat and will leak; and in the second place, the difference of expansion between the valve spindle, which is completely surrounded by steam, and the steam chests holding the valves, which is on the outside, exposed to the atmosphere, will also cause the valves to leak. The valves commonly known as the Cornish double beat valves are obviously superior in principle to the spindle valves just described, and having been invented nearly a century ago, and been in constant use ever since, it may be presumed that their general introduction in the double acting steam engine, where balanced valves are used, has been prevented or retarded by the difficulties presented for their adaptation to that purpose. These difficulties might be of the space occupied, or of the expense, or of such an adaptation as would alter but little the arrangements of the existing parts of the engine. My object is to endeavor to arrange these valves in such manner that the advantages gained by their superiority in principle may not be so counterbalanced by the difficulties above named, as to prevent their general introduction. To effect this I arrange the valves on the same level; as this is the arrangement most generally adopted in engines having balanced valves; and I also for the same purpose introduce certain peculiarities in the construction of the valve, that render it different from any hitherto in use. I will now proceed to describe my arrangement by a reference to drawings; and as I know of no instance where the particular variety of Cornish valve that I adopt has been made or used in this country, and of no work where it is described with a figured reference to drawings, I will also describe this valve, so that I can clearly point out the alterations I make.

Fig. 1 represents a side view of one of each of the steam and exhaust valves; the steam valve being the Cornish valve, and the exhaust valve having my improvement.

Fig. 2 represents a vertical section of the same valves both raised off their seats, which are also shown in section.

Fig. 3 represents a horizontal view of the same valves.

Fig. 4 represents a vertical section of the side pipes, steam chests, valves, and valve seats.

Fig. 5 represents a horizontal cross section of the lower steam chest-valves and valve seats taken through the dot line *x x*, of fig. 4.

Fig. 6 represents a horizontal view of the lower steam chest.

Fig. 7 represents a vertical section of the side pipes, taken through the dot line *y y*, of fig. 4.

In the drawing, figured as above, *a*, is the lower steam-chest; *b* is the upper steam-chest; *c* and *c* are the side pipes, leading respectively to the boiler and condenser; *d* and *d* are the openings from the side pipes into the cylinder nozzles; *e* is the opening into the condenser.

h h represents the two steam valves, differing but little, if any, from the Cornish valve; *m* and *m* represents the two exhaust valves, showing the alterations that I make to adapt them to the position in which they are placed relatively to the steam passages. I will in the first place describe the different parts of the Cornish valve.

f and *f* are respectively the lower and upper seats, the upper seat being formed on the circumference of a disk supported by a cross; *g g*, cast in the centre of the ring, forming the lower seat; the valve *h* is formed by a hollow cylinder, the lower part of which being turned in, as shown, forms the valve face *i*; that rests on the seat *f*; and the upper part also turned in, forms the valve face *i*; that rests on the seat *f*; *k k* are ribs cast on the inside of the valve to guide it; *l* is a cross by which the valve is lifted by the valve stem.

The steam-valve *h*, thus drawn and described, does not differ materially, if in any respect, from a Cornish double

Fig. 1.

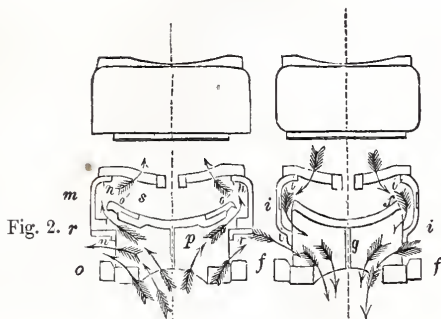


Fig. 2. r

Fig. 3.

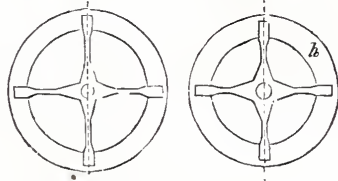


Fig. 5.

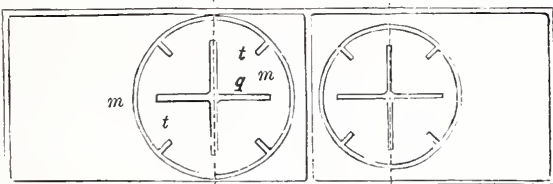
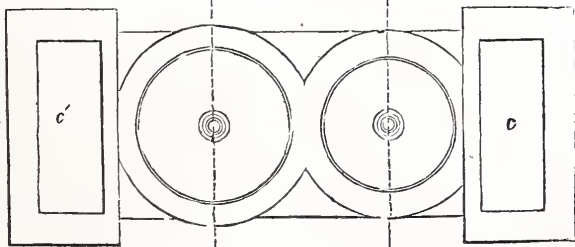


Fig. 6.

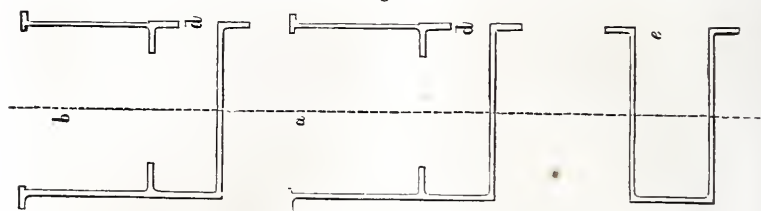


beat valve; and I have been thus particular in describing it, as I wish to explain the manner in which I alter it; this alteration constituting the material part of my invention.

It will be observed by a reference to

the drawing that the position of the exhaust valve with respect to the steam passages, and also with regard to the direction in which it is opened, is such, that if it were made similar to the valve just described, the pressure of the steam

Fig. 2.



would force it from its seat. It is necessary, therefore, in order that the valve shall be retained on its seat by the pressure of the steam, that the seat formed on the disk supported by the ribs shall be larger in diameter than the seat that forms the circular opening through which the steam passes. In order to effect this I attach a ring to the valve, forming the bearing for the smaller seat, this ring being smaller in diameter than the disk. I also attach a ring to this disk forming the larger seat. I am thus enabled to put the valve together by slipping the smaller ring over the disk, and then by attaching the larger ring to the disk; and finally by slipping the valve over the disk, and attaching it to the smaller ring.

The faces of this valve having respectively the smaller and larger diameter are represented respectively by n and n' , resting on the seats o and o' ; p is the disk supported by the cross q . The valve I form in two pieces by bolting it to the ring r , on the edge of which the smaller valve face n is shown, and the disk I also form into two pieces, by bolting to the disk p the ring s , on the edge of which the larger valve seat o' is shown. To put the valve in its place, the ring r must be slipped over the disk p , then the ring s must be bolted to the disk p , and finally the remainder of the valve must be slipped over the disk p , and ring s , and bolted to the ring r ; u is a cross by which the valve is lifted by the valve stem, tt are ribs to guide the valve. From the position in which this valve m is shown in reference to the steam passages, it will be seen that when the valve is closed the pressure of steam will be below the valve, and the vacuum will be above the valve; it will also be seen from the construction of the valve that it will be held down on its seat by the pressure of the steam acting from below.

WHIPPLE'S IMPROVEMENT IN MACHINES FOR PREPARING CLAY FOR MAKING BRICK.

Patent dated March 25, 1851.

Fig. 1 is a diagram illustrating the pulverizing or crushing action of the machine.

Fig. 2 is a side elevation of the machine.

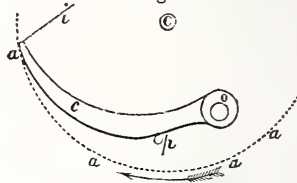
Fig. 3 is a front or end elevation.

Fig. 4 is a longitudinal section.

Fig. 5 is a transverse section.

The same letters of reference denote similar parts throughout each of the several figures.

Fig. 1.



The nature of my machine consists in the use of a revolving screen working on a stationary axis set at a slight inclination from a horizontal position, and having attached to, or suspended from it, lugs or crushers, which, by their weight, serve to pulverize the clay; the stock or clay being fed in at one end of the screen, which by its revolving motion carries or drags the stock under the lugs or crushers, thereby breaking and pounding it; the pulverized clay falling through the apertures of the screen, and the waste or hard lumps and stones mixed up with the stock being expelled at the back or lower end of the screen.

AA are uprights having cross or tie pieces bbb , which constitute the framing of the machine, or any similar suitable form of framing may be adopted; aaa , are the bars forming the screen, they may be placed at any required distance

Fig. 3.

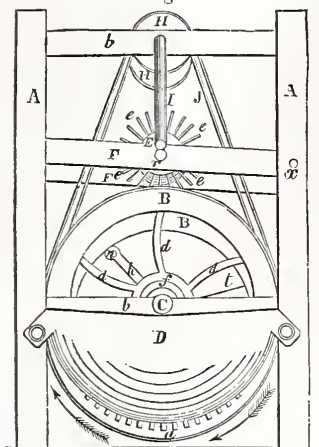


Fig. 2.

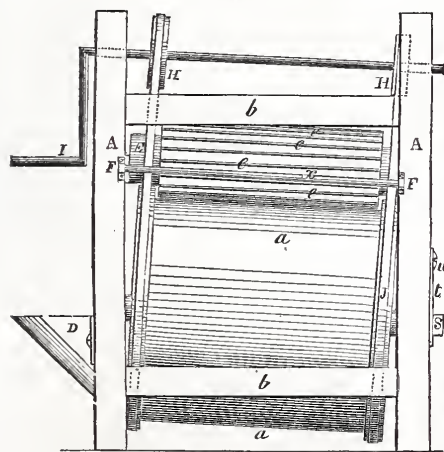


Fig. 4.

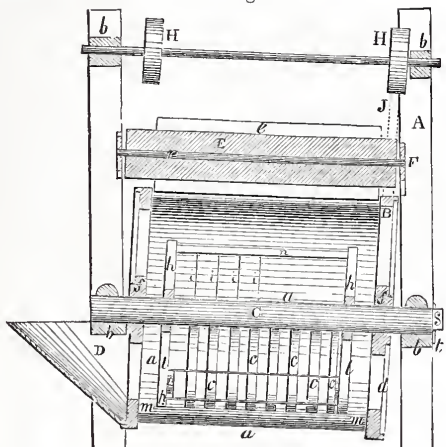
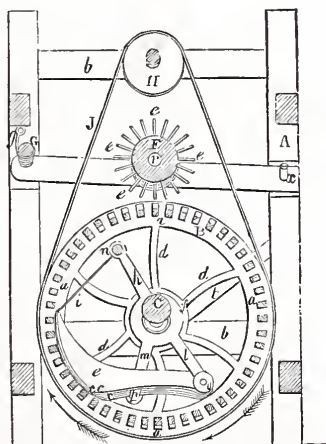


Fig. 5.



apart, and are bound, or secured, in a cylindrical form, by hoops *BB*, into notches in which the ends of the bars *aaa* may fit, or be otherwise attached. To the hoops *BB*, are arms *ddd* connected, with naves *FF*, which form the rotary bearings of the screen; the bars *aaa*, should be of such a shape in their cross section and so arranged as that any particles once entering the spaces, from within, between them, will readily pass off, that is, they should be broader on their interior, than their exterior edges, thus making the outside width of the spaces great-

er than the inside, as is the case with many descriptions of fire-grates now in use; and for which purpose bars of a triangular, or any appropriate shape may be used, their narrowest, or curved face or sides being set outside: or the screen may be made of a cylinder having slots or openings corresponding to spaces formed by the bars *aaaa*. *c* is the stationary axis on which the naves *FF* of the screen rotate, it rests on the lower cross pieces *bb*, and is kept, or prevented, from turning, by its back end *s*, being made square, and an arm *t*, being fitted into it,

the other end of the arm *t*, being fastened to one of the uprights *A* by a screw *u* (Fig. 2), or any other simple and well known arrangement may be used for keeping the axis *c* stationary; which is set, as will be seen by reference to the drawings, at a slight inclination from the horizontal position, for the purpose of giving the screen a corresponding position, or a dip at its back end. *D* is a feed hopper or trough which also is stationary. To the axis *c*, are keyed, or otherwise secured, arms *h h l l m m*, seen more particularly in Figs. 4 and 5. *n*, is a cross bar connecting the arms *h h*. *o*, is a bar connecting similar arms *l l*, and *p* a rod connecting the arms *m m*. *c c c c c*, are lugs or crushers having their fulcrum, or working as a hinge joint, on the rod *o*, and at their other extremity attached by cords or chains *i i i i*, to the bar *n*, and resting on at their lower edge, or supported, by the rod *p*; either arrangement of the arms *h h*, cords or chains *i i i i*, or cross bar *p* and arms *m m*, may be used for supporting or holding the lugs from touching or rubbing, the screen: or both arrangements as shown and described in combination, may be used. The lugs, or crushers *c c c c c*, may be made of any material, size, shape and weight. *e e e e*, are pickers, arranged in a radial form round a small drum *E*, keyed to an axis *r*, working at either end in side levers, or pieces *F F*. The pickers *e e e e*, are of nearly the same length as the bars *a a a a*, of the screen, and are of proper thickness and width apart to drop into the spaces between the bars *a a a a*. The side levers *F F* are hung on a rod *x*, forming a joint on which to work, and their other end connected by a bar *G*, which is held by a catch, or hook *g* (Fig. 5). *H H*, are pulleys being driven by a handle *I*, attached to their shaft or axis. The pulleys *H H*, serve to drive the screen by straps *J J*, which pass round them and the hoops *B B*.

I will now proceed further to describe the operation. The stock, or rough clay, is fed by the hopper *D*, into the screen formed of bars *a a a a*, entering under the lugs *c c c c c*, and by the revolving motion of the screen in the direction shown by arrow, Figs. 1, 3 and 5, the stock is carried under the lugs *c c c c c*, which yield, or give, working on their joint *o*, and so produce a pressure by their

weight, on the clay, which serves to clear the stock, the fine and workable portion being pulverized, and passing through the spaces between the bars *a a a a*, and the waste, or hard lumps and stones mixed up in the stock, being worked out of the back end of the screen, the inclination of which downwards, and the revolving motion of the screen serving to expel the same. The object of the rod *p*, or cords *i i i i*, is to prevent the lugs from rubbing the screen, which would create unnecessary friction. The several lugs, or crushers may be made of different sizes, shapes or weights; those at the mouth of the screen, if desirable, made so as to merely break the stock, and the after crushers, or lugs, to pulverize the finer clay which is collected under the screen formed by the bars *a a a a*, and is thus tempered or prepared for making bricks.

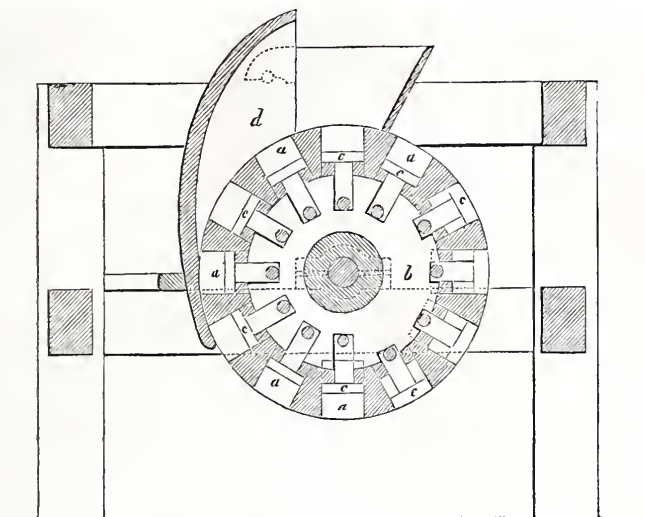
The pickers *e e e e*, may be thrown in or out of gear with the bars *a a a a*, by lowering or raising the side levers *F F*, working as a hinge joint on the rod *x*. By unfastening the hook *g* (Fig. 5), the pickers *e e e e* are thrown in gear, entering the spaces of the bars *a a a a*, which, as the screen rotates drives or causes to rotate also the pickers *e e e e*, which pick out, or clear the screen of any soft clay or dirt which may clog the spaces between the bars *a a a a*. By the hook *g*, the picker is thrown in or out of gear, and used only as required.

BRICK PRESS.

*Patented by John Riddle, Covington, Ky.,
April, 1851.*

In order to the formation by simple pressure, from untempered clay, of bricks, possessing the requisite unity and coherency of structure, it is absolutely essential that the pressure should be uniform throughout their entire mass.

This result has never, to my knowledge, been attained, except by the application of pistons on opposite sides of the brick; but this mode, although (while the machinery remains in working order) adequate to the formation of a good article, is particularly ineligible, on account of its liability to clog, and become deranged. The fact is, a brick machine should have as few working joints as possible, especi-



ally in those parts which are in immediate connection with the clay.

Machines, in which the bricks are formed either in the circumference of a large wheel or in a straight bed of moulds, in connection with a wheel, by a simple rolling motion, have the requisite simplicity, but the pressure not being applied to all parts of the clay at once, the mass, while being pressed down at one part, rises up at other parts, which have passed the point of pressure, and cracks and becomes unequal in consistence, and having once taken its set, no pressure, afterwards, is adequate to rectify the defect. These difficulties I have entirely overcome by a working machine, containing the following devices, to wit:

Fig. 1. is a longitudinal section through the mould-wheel and its appurtenances.

The moulds, *a*, are placed around the perimeter, of a wheel, *b*, and the pressed brick may be extruded, by followers, *c*, which may fall back against a solid shoulder in the wheel, as usual.

The distinguishing features, however, of my arrangement, exist in the peculiar construction of the feed trough, *d*, and its appendages; the trough is made to gradually narrow downwards, until it comes closely in contact with the rim of the wheel, and is thence extended forward in the form of a lip or flange, *o*, hugging closely the wheel, and made to bear hard

up against it, so that the clay, after its introduction into the trough, is squeezed into a smaller and smaller compass, as it descends, and by this means is pressed forcibly into the mould, until coming in contact with the lip, the entire mass receives its ultimate compression powerfully and equally applied in every part.

R. COOK'S TUYERE, OR BLAST PIPE.

Patented by R. Cook, of New-York.

The nature of my invention consists in a mode of partially arresting and returning to the fire the escaping products of combustion, so that the combustible gases and particles of carbonary be there consumed, with the double benefit of effecting a saving in fuel and abating the nuisance created by the smoke.

My method of doing this is by what I denominate a double tuyere or blast-pipe. This tuyere is constructed of two pipes, one of which enters within the other before reaching the end from which the blast emerges.

Fig. 1. shows my method of applying said tuyere to a heating oven or a reverberatory furnace. *A* is the heating oven. *B* is the gas chamber where the escaping products of combustion are gathered and partially arrested in their progress to the chimney. *D* is a stop-cock. *E* is the smaller or interior pipe of the tuyere con-

ned with the gas chamber. F is the external pipe of this tuyere, in the upper end of which the blast enters.

Fig. 2 is a representation of this tuyere as disconnected from the heating oven.

Fig. 1.

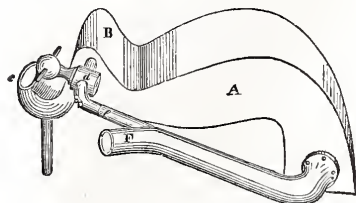


Fig. 2.

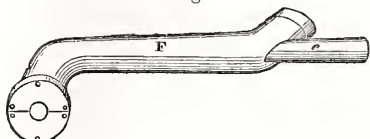


Fig. 3.



A blast of air entering either of these pipes at the end, where they branch or separate, will create a draught through the other pipe, moving in the same direction as the blast, and discharging through the orifice common to both pipes: when, therefore, this tuyere is attached to the heating oven, as shown in Fig. 1, the blast, entering at the pipe, F, will, in passing over the end of the pipe, E, create a partial vacuum at its lower orifice, causing a draught through the pipe, E, and in this way the smoke and other products of combustion will be drawn from the gas chamber, and mingling with the atmosphere of the blast, will be returned to the fire-box of the heating oven. As these arrested gases, mixed with fresh oxygen, are made to enter the fire-box, beneath the grate, they must subsequently pass through the fire and be thoroughly exposed to combustion.

Fig. 3 is a sectional view of this double tuyere, the upper half of the exterior pipe being removed. The contraction

of the outer pipe, close to the end of the inner one, as shown in this figure, is adapted for the purpose of creating a draught through the interior pipe with the use of a much less volume of air in the blast than would be otherwise required.

WILSON'S SEWING MACHINE.

Patented by Mr. Watson, of New-Jersey.

The machine of Mr. Watson uses two threads to form the stitch, the one thread by a shuttle and the other by a needle—the motion of the two being regulated to form a lock-stitch, which will not rip out. It produces one stitch during the forward and another during the backward motion of the shuttle. The manner in which the cloth is fed-in to sew curved seams is beautiful.

Fig. 1 is a vertical transverse section; fig. 2 is part of a plan view; fig. 3 is a detached longitudinal vertical section. The same letters of reference indicate like parts. A is a long table, which supports the machinery; B is the bed plate, smoothed to fit into the table. There are two pillars F F to support plates and shafts; G is a top plate, and H is an intermediate one; C is the main shaft, and D is a fly-wheel on it. E is a crank handle. There is a cylinder on the main shaft, having an eccentric groove in it (shown by the dotted lines). This eccentric groove operates the forked arm, M, of the needle, which has pins in it inserted in the groove, which gives an out-and-in motion to the needle, when the handle, E, is turned. On the other side of the fly-wheel there is a cam for operating the ratched arm, W, which has a pall on its lower end to take into a ratchet wheel on the spindle below, and turn it. P is a pinion on the small horizontal shaft, which is turned by a cog wheel on the main shaft above. L is a lever which hangs down to vibrate and operate the shuttle bar backwards and forwards. The spool is not seen, but the thread is shown passing behind the needle arm, M. The needle is at the lower end. The shuttle, 5, is like a weaver's, and is moved backwards and forwards, as on a loom. The bar on the plate, fig. 2, has two spring fingers embracing the shuttle in its race-way, and there is a pin on the inside of each finger. There are two pins on the

Fig. 1.

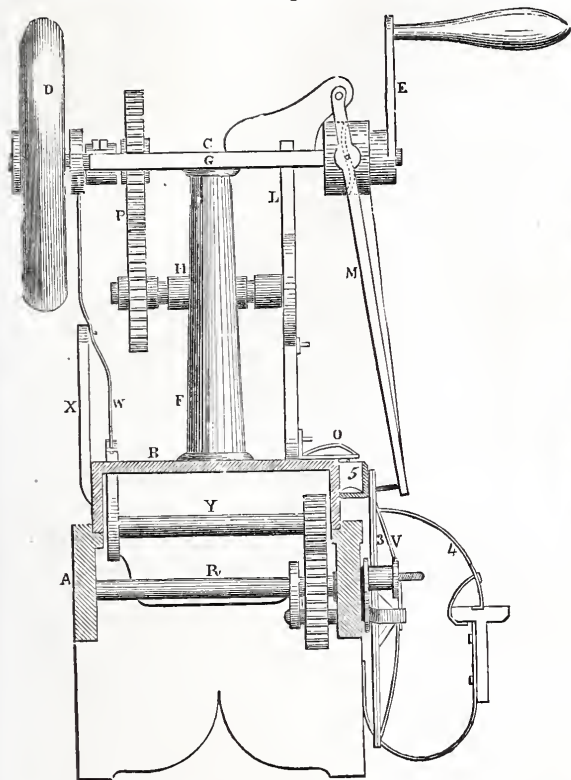


Fig. 2.

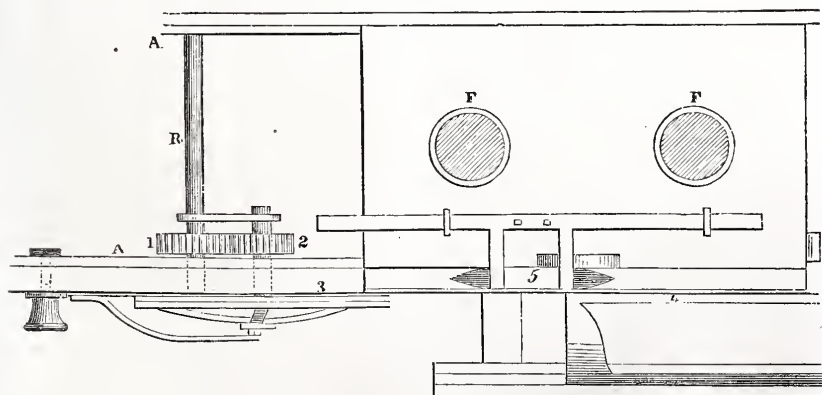
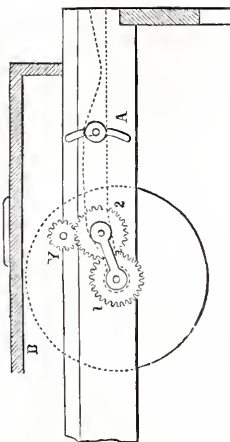


Fig. 3.



bar above the shuttle, between which is embraced the vibrating lever, L, fig. 1,

therefore when the said lever is vibrated, the shuttle bar is moved backwards and

forwards—once backwards and once forwards for every two stitches of the needle. The pins on the inside of the fingers must be lifted when the shuttle is passing through the loop *g* fig. 1 (formed by the thread of the needle behind the cloth), and this is done by a projection on the plate, above the shuttle behind the fingers. Each finger is thrown out alternately, so that one holds the shuttle while the other is free, and thus the shuttle passes through the needle loop, forming the lock stitch. This is the way the shuttle is operated:—

The feed motion of the cloth to be sewed is peculiar—two circular plates being employed for that purpose (the edges of them only are seen in the figures). *R* is a spindle which carries a toothed wheel loose upon it, and there is a small spindle with a fast wheel, 2, upon it. The outer end of this small spindle carries the flat round plate, 3, which can be adjusted to different heights, to suit the sewing of large and small garments, &c. *v* is a circular plate, concave on the inside, and is of the same size as plate 3. The cloth is confined between these two plates, the concave parts allowing for the folds, so that any curved seam may be arranged on the periphery, packing the folds inside, and as these plates revolve, the needle passes through the cloth at the edge, and thus sews circular, or any kind of curved seam. In figs. 1 and 3 there is a spindle *x* with a pinion on it gearing into wheel 2. This spindle has a ratchet-wheel on it, which is operated by the ratchet-arm *w* which is hung on a centre pin on the post *x* and thus motion is given from the main-shaft above to the spindles *x* and *r* below, to give the plates 3 and *v* a rotary motion to feed the cloth to the needle, and this is done at regular stitch distance for every stroke. For sewing straight seams, a different cloth holder is used, but this needs no explanation, such an arrangement being easily constructed. For sewing curved seams, it will easily be perceived how Mr. Watson has exercised a beautiful ingenuity. The one round plate being open concave, and the other flat, allows a seam of any curve to be arranged to the action of the needle, and the two plates are then pressed together by a spring on the bow-plate, 4 (fig. 1), to hold the cloth snugly between the plates.

When the main shaft, *c*, is revolved,

the needle-arm is vibrated by the eccentric grooved cylinder; the cam works the ratchet arm *w*; the lever *z* gets its vibratory motion likewise from a crank pin on the spindle of the pinion *r*, which works in a slot in the lever,—and thus the vibratory and rotary motions to work the needle, shuttle, and revolving plates, are derived from the main shaft *c*, when the crank handle *e* is turned by the operator.

CAST IRON GIRDERS.

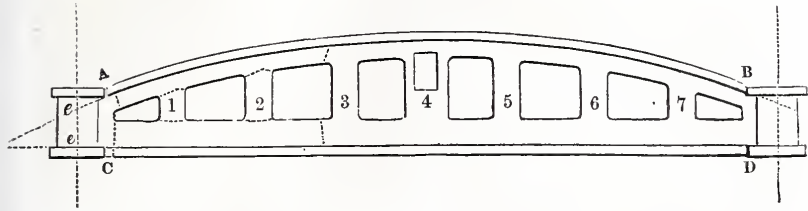
The application of cast iron to buildings is of comparatively recent introduction; nor was it till lately, that extensive researches were made into the properties of this metal with the view of developing principles, that should guide us in such constructions. Its great power of resistance, and the facility of moulding it into various shapes, so as to admit of its applications in innumerable cases, make it one of the most important materials for the architect and engineer.

Structures, where it has been successfully used, are an important study, for they serve as a guide, how to apply it; cases of failure are of equal, if not higher importance. The inquiry into the cause of fracture leads us to search for and detect, the mode of action going on among the fibres, when submitted to a strain—shows, where there was deficiency of strength—where abundance, and eventually teaches us the principles of that harmony of construction, whereon depends the stability.

The successful structure only proves that every where the casting was strong enough—but does not point out whether due economy has been exercised. We must, therefore, be peculiarly careful to ascertain the true cause of failure, and not be led by appearances to a false reasoning. This may lead to false results, and thus into the danger of errors in new constructions, which again will produce equally disastrous results. I am led to these reflections by the remarks in the January and April Nos. of this journal, on the failure of a cast iron girder.

We there have two investigations into the cause of fracture placed before us. Both arrive at the same conclusion—the weakness of the beam; which in fact is no wonder, as it actually broke.

Fig. 1.



Both find the first, or indirect cause, in the openings left in the web, but as to the immediate cause of fracture the opinions differ. Mr. Fairbairn says, the openings produced unequal shrinkage in cooling; this caused a primary strain among the particles; this strain weakened the beam to such an extent, as to break with the comparatively light weight of 80 tons.

Mr. Whipple reasons differently, and tries to prove, by calculation, that the openings reduced the power of resistance to the horizontal thrust in the arch, and he says "the breaking of the beam involves no mystery and should excite no surprise; it was not occasioned by any defect in the strength and texture of the metal, occasioned by unequal shrinkage in cooling, or any thing else." He completely overthrows Mr. Fairbairn's explanation.

It may not prove uninteresting to examine these two statements, and try to find out which is correct. Mr. Fairbairn further on condemns girders with open web as unsafe, from the reasons stated above. According to Mr. Whipple, there is no harm in such openings, no danger from unequal shrinkage, so long as a sufficient mass of metal be there to take up the thrust of the rafters, whether cast on, or provided for, by a sufficient tie-rod. Mr. Fairbairn may, perhaps, not be so well known in this country as Mr. Whipple, and we premise, therefore, that he has probably had more experience in the application of cast iron to buildings than any other engineer; and his indefatigable researches into and experiments on the strength of this material, for a long time, in connection with Mr. Hodgekinson, have been embodied in various treatises by both these gentlemen, which, in Europe, are acknowledged the highest authority on this branch of mechanics. As such, Mr. Fairbairn's opinion is enti-

tled to some credit, and can scarcely be overthrown, except by arguments based on an experience equally extensive with his.

Mr. Whipple seems to suspect in Mr. Fairbairn's opinion the acknowledgment of a mysterious, hidden agent, for his argument (as above quoted) begins with denying the existence of a "mystery." But surely shrinkage is no mystery. Its amount is well known, and is calculated accurately in making patterns for such large castings; nor is it to be trifled with, for it amounts to about $\frac{1}{8}$ of an inch per foot—that is, the pattern of this beam would have to be about $2\frac{1}{2}$ inches longer than the finished casting was intended to be. Wherever there is action, there must be a power to produce it. Shrinkage is a contracting of the particles which have been expanded—thrust asunder by the action of heat. Knowing the power of cast iron in resisting compression, and its comparatively small cohesive power, we may imagine the greatness of the force which, during shrinkage, is active among the particles of the casting, to compress them without separating any one group from another. This view of the case shows the importance of so proportioning a large casting, as throughout its entire length and depth to balance mass with active power, or resistance with power, so that, during shrinkage, the equilibrium between the particles be not destroyed. For when any one part is cooled before the rest of the casting, then, its contraction having attained its ultimate limit, the power of resistance active within its fibres also ceases to act. It is evident, then, that while other parts of the casting are still contracting, there will be a line or boundary in the structure between that part where these forces are still active and that where they no longer act. It is here that a primary strain

Fig. 8.

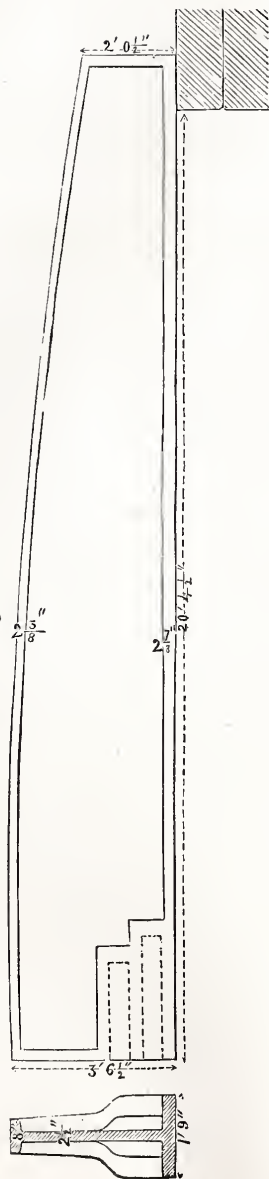


Fig. 2.

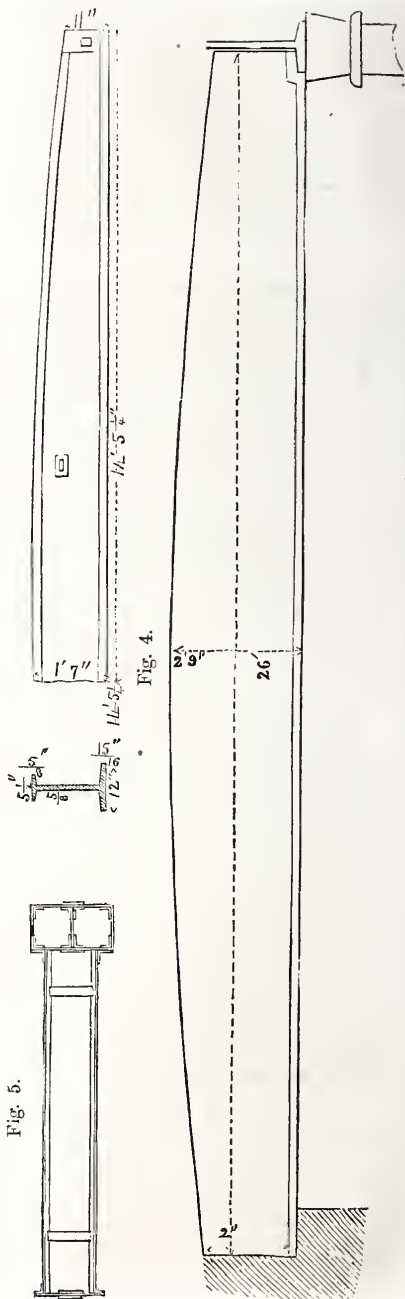


Fig. 4.

Fig. 5.



among the fibres will occur: the casting may be so proportioned that fracture takes place here during cooling, or so that it shall break when an additional external strain is brought to bear on it. The cutting of the rim, or hub, when casting wheels, is done to prevent this injurious action of unequal shrinkage, and was adopted in consequence of the experience of failures, when it was omitted.

Such a want of due proportion we find on the beam in question, as shown on page 11, figs. 2 and 3. The centre, with its great depth, and heavy vertical ribs and shelves, and the glands at the ends, would both continue hot long after the light web between them had already cooled to its ultimate limit of contraction. Both these parts would, therefore, during their final shrinkage, act on the part between them in the direction of extending its fibres, or tearing them asunder. Had the web been solid, the effect of unequal contraction would not have been so injurious, because it would not have been so extensive. The pieces left out weakened that part in itself, even before the extra strain was brought on the fibres. The place of fracture corroborates this explanation. Mr. Fairbairn estimates the strength of this beam, if left solid, at 280 tons; the openings would reduce this, say one third; it broke with 80 tons. This would leave about one third of the strength of solid beam as measure of the strain due to shrinkage, or to the disturbed cohesive power of the metal.* We notice the same result in shrinking a tyre on a driving wheel too tight. The cohesive power of wrought iron, or its power of resistance to any force tending to tear the fibres asunder, is very great—on that depends the shrinking of any band on a centre. But if the band or tyre be made so much smaller than the centre it fits on, that the whole, or nearly the whole of its cohesive power is absorbed in keeping the fibres from tearing, then, when external strain comes, (the

hammering it receives as it rolls along the road), it will gradually yield till it bursts,—the *time* depending on the amount of resistive force still disengaged in the iron—the place, upon the weakest or least sound part. So much for Mr. Fairbairn's view. Now to Mr. Whipple's explanation. He calculates the strength of this girder as he would of an arch or truss. He distinctly affirms (page 220, quoted as above), that a defect in the texture of the metal from unequal shrinkage, had nothing to do with weakening the beam, or causing fracture; and according to Mr. Hopkinson's statement (in No. 1 of this journal), there was no mechanical unsoundness in the casting, such as blow or sandholes, honeycombs, &c. It was a good sound casting. If not, so important a fact would not have been overlooked or suppressed by either of the engineers examined. He calculates the horizontal thrust in the top flange, or "rafters of the truss," at 537,000 lbs. viz. 3 times the load of 80 tons. He also calculates the power of resistance of each "rafter" and its abutment on the "tie beam," at 603,000 lbs. Now, the two rafters would be 1206,000 lbs. against a thrust of 537,000 lbs., or less than one half; an excess sufficient to insure safety.

The rafters, however, do not take up the entire thrust. Viewed as a truss, it consists of three elements; the rafters, the main beam, and the pillars, which take up considerable of the weight and strain on rafters, and transfer it on the straight beam. If we now calculate, from known rules, the strength of this straight beam to resist a load transversely, and diffused throughout its whole length by the sturdy pillars 1-7, also, the strength of rafters to resist the horizontal thrust—we shall find that the beam was too strong, instead of too weak, and would have safely carried the 280 tons, instead of breaking with 80 tons—always provided there was no other principle active to weaken it, which, according to Mr. Whipple did not exist.

Spite of the calculation, the beam broke with 80 tons, and consequently we must look for some other cause. This calculation, or its application to a straight girder, certainly is founded on an erroneous principle. The second result Mr. Whipple arrives at is this (page 221): "It is

* The amount of this strain, together with the position of the strained fibres, ought to be experimentally ascertained, by casting two such beams, on a small scale, exactly alike, the one with the openings, the other solid. Then by drilling and slotting machines cut the same openings out of the solid one, and load both to their breaking weight. If the above remarks, and Mr. Fairbairn's explanation be correct, then the latter beam ought to bear more than the one with openings cast in.

gross folly to build an open arched girder, in which the axis of the arch does not meet that of its cord, which is to sustain its thrust, as nearly as may be over the centre of the supporting force."

A F B, fig. 1, is the arch, but what is the chord? Certainly not the bottom flange C D, as intimated in sketch, page 220. The chord is A B. Still treating the girder as a truss, then A C D B is a beam, trussed by the triangle A F B.

The best truss for a beam, for instance a wooden one, is a triangle, or a combination of triangles, generally obtained by iron rods. If a cast iron girder with arched top is to be considered so, why not make the top flange in the shape of a triangle instead of an arch? Because that has been found an insecure construction. This would at once lead to the supposition, that a girder resists the strains differently than a truss. Of arches, the circular are the strongest, and the nearer they approach the half circle the stronger they become; a half ellipsis is also used, because it transfers the strain *vertically* to the abutments. But for the top flange of a girder, the parabolic curve, or the flat part of an ellipsis is the best, as demonstrated by science and proved by experience. Both these curves are the very worst for arches, i. e. when the arch has to carry the weight. To calculate the strength of the girder on the principles of an arch or truss, is therefore inadmissible, and would lead to false constructions. Mr. Whipple's second inference (page 221), therefore falls to the ground.

As proof that in practice his notion never obtains, I add sketches of two or three beams or girders, with arched tops, in fig. 2—a girder of Mr. Fairbairn's construction, for a fire-proof mill, with cross section, figs. 3 and 4—girders carrying the Rail Road through Manchester, (England); all of which have stood for many years, and proved sufficient, while, considering the load they have to carry, there seems no waste of metal. Yet in neither does the arch meet the (supposed) chord in the manner required by Mr. Whipple in that paragraph, and shown in his sketch. Following his own reasoning, should the points of support be removed to where the arch, continued, would meet the lower flange, or would he have given the arch a quicker sweep,

so as to make the lower flange the real chord? In either case, common sense tells us the beam would scarcely carry its own weight.

His view, in fact, solely applies in such beams, as are frequently used in this city, where the casting is in the shape of a *bona fide* arch, its lower points tied by a wrought iron tension rod—probably the worst, and (as regards economy in distribution of metal) the most extravagant way of applying cast iron.

An open web girder looks like an arch or truss, but must be calculated on the same principles as the solid web beam, making allowance for the weakness arising from the causes stated before.

Two questions arise out of the above.

1st. What mode of action goes on among the fibres or particles of a girder in resisting the strain caused by a load placed between the points of support?

2d. What is the advantage of curving or arching the top flange, and how is the best curve to be determined?

The action among the fibres in a loaded straight girder is twofold, according to their position. When the load is too great, it produces a deflection of the beam. The upper fibres then are compressed, and oppose the strain by their power to resist compression, while the lower fibres are extended, and oppose the strain by their cohesive power, or power to resist extension.* The strain to which each longitudinal fibre is exposed, and its power of resistance, depend on their relative position to the boundary line between these two opposite forces, which line is the neutral axis. "The farther removed from it, the greater the power of resistance."

"The position of this axis depends on the total depth of the beam, and is about $\frac{2}{3}$ of the whole height above the lower edge."† The nature of the material determines the manner of its distribution above and below the axis.

Cast iron offers greater power of resist-

* A stick of some depth, supported at the ends and loaded in the centre till it breaks, will, by its sections of fractures, illustrate this double action among the fibres.

† It is not necessary to enter into detailed calculation of its position. Those who wish accurately to determine it, are referred to the works of Barlow, Moseley, Weisbach, and others.

ance to compression than to extension; there we must have a greater *mass* of metal below the neutral axis than above it; so that the greater number of fibres, among which the strain is divided, may compensate for their smaller individual strength, so that the sum of resistances of the extended fibres equals the sum of resistances of the compressed fibres. On this depends the *harmony of construction*—the equilibrium among the fibres, by which all are equally strained, and, when loaded to breaking, all come to the point of rupture at the same time.

In wrought iron, the proportion of those two powers of resistance is more nearly alike (being as 90 to 66, while in cast iron it is as 140 to 19), and in girders of exclusively this material (for instance the Britannia bridge, and Fairbairn's wrought iron girders), the *mass* of material above the neutral axis is greater than that below it; or, what comes to the same, the mode of construction of bracing is stronger than below. In the constructions, the upper flange, or what represents them, the upper cells, have a larger sectional area than the lower flange or cells (Fig. 5, of Fairbairn's girder).

Having determined the *mass* of material in the top or bottom part of beam, that is, its cross-section, the simplest way would be to make it parallel. Experiments, however, proved a more economical distribution possible and compatible with the equilibrium of particles. For the upper fibres, as they approach the points of support, increase in strength, leverage decreasing; this gave rise to the curving or arching of the upper flange. The curve is determined thus, that the decrease in mass be proportional to increase of strength—an object attained, not by the circle, but by the parabola—the worst curve, if it had to bear on the principle of an arch. The circle is generally used—but it is a faulty construction, adapted (as the injury may be obviated by the use of a trifle more metal) for the sake of an easier laying out.

We arrive then at the following conclusions:

That Mr. Fairbairn's view of the cause of fracture is the only correct one.

That we agree with both Mr. Fairbairn and Mr. Whipple (at least partly) in considering injudicious a girder with an open web.

That Mr. Whipple's second inference (page 221) is based on an erroneous view of the forces active among the fibres.

His third inference was disposed of before.

T. PASSAVANT.

NEW-YORK.

SAMUEL CORNELL'S LEAD-PIPE MACHINE.

We were extremely gratified a few days since by a visit to the lead pipe manufactory of Samuel Cornell, No. 243 Water-street. Although familiar with the process of manufacturing lead pipe as described in the specification of the patentees, we had never witnessed the actual operation before, and one who has not can form but a slight idea of the power exhibited by this machine.

To such of our readers as are not familiar with this branch of manufacturing, it may be well to sketch the progress of the machine, from its first conception to its present state of perfection.

Until 1820 lead pipe was manufactured by casting and drawing, something similar to the process of wire-drawing. In 1820, Burr took out a patent in England on the following plan: (in these figures, so much of the machine is represented as is essential to illustrate the *principle* of its action, without aiming at accuracy of detail.) A hollow cylinder, *c*, of cast iron (fig. 1) is furnished with a steel die, *d*, of the shape and dimensions of the outside of the proposed pipe. A solid piston or ram, *r*, of cast iron, fits this hollow cylinder as snugly as possible, without friction. To the bottom of this piston is affixed a steel mandril or core, *m*, of the length of the cylinder, and of the diameter of the bore of the proposed pipe. When this piston is withdrawn from the cylinder, the point of the mandril is just within the die at the bottom of the cylinder. The cylinder is then filled with melted lead, which is allowed to set. By the action of a hydrostatic press the cylinder is then raised between guides, or the piston lowered (it matters not which), and the solid lead is forced by the action of the piston through the die, and enveloping the mandril runs off the point of the latter as lead pipe. This action continues until the piston has reached the

Fig. 1.

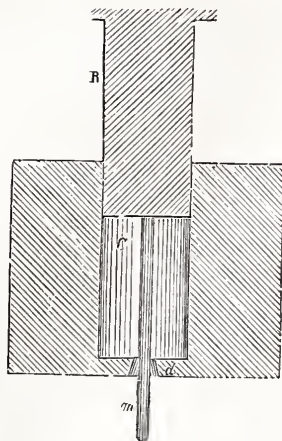


Fig. 2.

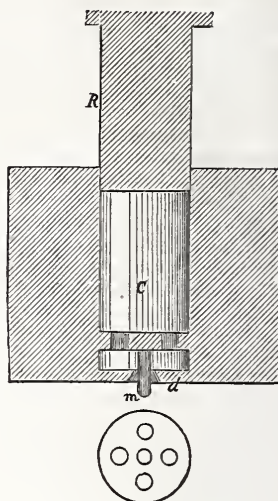


Fig. 3.

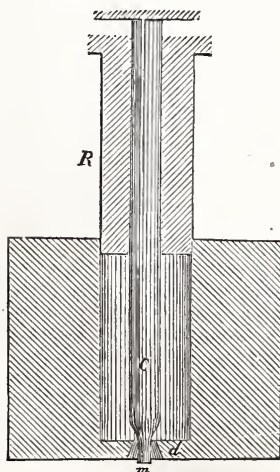
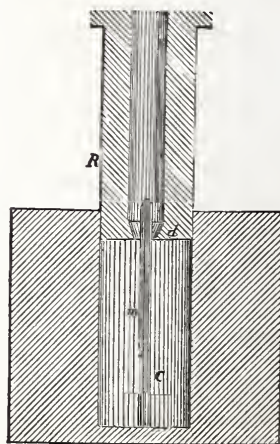


Fig. 4.



bottom of the cylinder, when the mandril projects nearly its whole length through the bottom of the cylinder.

This was a great improvement on the

old method of drawing, but yet accompanied with some objections, one of the most prominent being that, for small pipe, the mandril lacked stiffness to preserve

itself from derangement, and the pipe in consequence was irregular in its thickness.

To obviate this, Hanson took out a patent in Aug., 1837, the principle of which was, that the mandril was short, and instead of being fixed to the bottom of the piston or ram, as before, was fixed within the cylinder, and a few inches from the die to a plate or diaphragm, stretched across the cylinder, *a* (fig. 2). The mandril in this case being immovably fixed concentric with the die. To enable the lead to arrive at the die and mandril, this diaphragm or "bridge" was perforated by four large holes, shown in plan fig. 5, through which the lead in a solid state was forced by the action of the ram, but united again after passing the bridge and before reaching the die and mandril point.

By this means, it is true, the irregularity of the action of the mandril in Burr's plan was avoided, but at a great expense of power, and the pipe made was inferior, the lead not uniting after passing the bridge so perfectly, but that the pipe manufactured by this machine would split at the points corresponding to the divisions of the "bridge."

To overcome this difficulty, as well as that of Burr's, was the object of the patent of Tateham, dated Oct. 1841, in which the piston is truly bored from end to end, and a larger mandril or shaft (fig. 3) fitted within, nearly of the length of the cylinder, into the bottom of which is fixed the short core or mandril for the bore of the pipe, the mandril remaining as in Hanson's plan, fixed just within the die.

As the hollow piston descends* upon the lead (the mandril shaft rising meanwhile within it), the latter is forced around the shoulder of the mandril, and so through the die into pipe.

At first sight, and in model, this plan would appear to be very effectual, but in practice it is attended with some objections, the principal of which is the difficulty of preserving the smooth, and at the same time tight action of the hollow piston, and the mandril shaft moving within it.

It will be readily foreseen that the great power necessary for the manufacture of pipe, will force the lead between the mandril shaft and the bore of the piston, increasing the friction to a very great extent.

We come now to Cornell's improvement, and our object in writing this paper is to show the great value of his improvement over all that has preceded it in this manufacture.

It will be perceived that, in all the machines we have described, *the power is applied at one end of the mass of lead, and the pipe is made from the other end*; of course the whole power acts first in compressing the lead, and then, in this compressed state, forcing it along the cylinder, and in Tateham's patent, in addition to the friction of the cylinder, is to be added the friction of the larger surface of the mandril shaft.

Cornell's improvements consist simply in making the pipe from that part of the lead subjected to the action of the power, and not to move the mass of compressed lead *through* the cylinder to the die. This is effected by making the piston or ram a die holder, and hollow, and affixing the mandril to the bottom of the cylinder, and extending it to the die in the piston bottom (fig. 4). The effect is evident.

The instant the piston commences its movement, pipe is formed at the die, at one half the expenditure of power necessary when the mass of lead is moved through the cylinder. To prove this. It is evident that, of the three machines described as in use, viz., Burr's, Hanson's, and Tateham's; Burr's is attended with the least loss by friction. Supposing the friction at the die to be the same in all, (and there is no reason for a contrary conclusion), Burr's has merely the friction of the compressed lead moving along the sides of the cylinder, whereas in Hanson's, in addition to this, is the wire drawing through the four holes of the bridge, and in Tateham's the friction of the surface of the mandril shaft. We have then but to compare the relative expenditure of power between Burr's and Cornell's, to settle the question of improvement in this particular,

Dispensing with the mandril (the friction of which, for the same size of pipe, will be the same in both plans), if we take a cylinder of Burr's machine and put

* For convenience, we assume that the piston descends in all these machines, as it matters but little in elucidating the principle, whether the piston descends or the cylinder ascends, but the former method is more easily comprehended.

a die in the bottom, and then, instead of the solid piston used by him, take a hollow piston with a die of the same size in the bottom of it (constituting Cornell's machine), and filling the cylinder with lead, subject it or the piston to pressure, we have, it is evident, a means of testing the comparative friction of the two machines. This was accordingly done.

A cylinder of 6 inches in the bore, and $15\frac{1}{2}$ inches high, was filled with lead; the die, in the bottom of the cylinder, as also in the bottom of the piston, was of $\frac{1}{2}$ inch diameter. The temperature of the cylinder was about 180° ; upon applying the power to the cylinder, the lead wire rose from the die in the piston 23 feet, while the die in the cylinder bottom descended 10 inches! The whole length of wire made from the piston die was $145\frac{1}{2}$ feet, while that made from the cylinder die was but $26\frac{1}{4}$ feet; whole weight of wire, 170 lbs.; time occupied, 5 minutes.

This experiment was repeated, and always with the same result, to within a minute fraction. The dies were then changed, the cylinder die placed in the piston, and the piston die placed in the cylinder. The quantity of pipe now delivered from the die in the piston was $140\frac{1}{4}$ feet, while that from the bottom of the cylinder was but 30!—whole weight the same—and the time was 7 minutes.

2d. A hollow cylinder of two inches bore and ten inches in length, was then taken and filled with lead. Three minutes were allowed to elapse, and the cylinder was put into the press with a solid piston above it, and the lead was compressed one half inch within the cylinder, the cylinder was then reversed, the half inch space being below, and a power applied to the piston of about two tons per square inch, without starting the lead in the cylinder. A $\frac{3}{8}$ inch die was then placed upon the bottom of the piston in lieu of the solid disc, and upon applying a power of about one ton per square inch, the wire rose freely through the die in the piston. Upon examination, it was found that the lead below had not moved any distance appreciable with our means of measurement. The cylinder was again reversed, and the half inch space placed under the hollow piston, and upon applying the power, the wire rose as before; the balance exhibiting the same pressure.

3d. This experiment was extremely in-

teresting and very conclusive, as to the merits of Cornell's method of making pipe.

A hollow cylinder of five and a half inches in height, and two inches bore, was perforated with holes of quarter inch diameter, at intervals of half inch measured on the axis of the cylinder, the direction of the holes being perpendicular to this axis. The holes were plugged, and the cylinder filled with lead. After the lead had set, the plugs were removed, and the cylinder placed in the press. A die of three eighth inch bore placed at the bottom of the cylinder, and a die of the same dimensions placed at the bottom of the hollow piston. Upon applying the power, the wire rose first from the die in the hollow piston (representing Cornell's method): next from the first side hole at the top, then from the second side hole, and so on to the bottom side hole, the wire not appearing from the die in the bottom of the cylinder, until it had also made its appearance at the last side hole. The balance the while indicating a pressure the same as in the last experiment.

The lengths delivered at the different holes were as follows:

Piston die 8 feet.	
1st hole	$5\frac{1}{2}$ inches.
2d "	$10\frac{1}{2}$ "
3d "	$13\frac{1}{2}$ "
4th "	$11\frac{1}{2}$ "
5th "	12 "
6th "	$12\frac{1}{4}$ "
7th "	12 "
8th "	$11\frac{1}{2}$ "
9th "	$10\frac{1}{2}$ "
10th "	$9\frac{1}{2}$ "
Cylinder die	1 foot.

Whole weight of wire 6 lb. 7 oz.

It would appear from the 2d experiment, that with the small orifice used, and in a cylinder of ten inches in length, the friction of the lead against the cylinder by Burr's plan, is greater than the power requisite to make the pipe by Cornell's improvement. And the whole experiments show, that the methods of Bur, Hanson, and Tateham, are vicious; in that the enormous friction of the moving mass of lead necessitated by their methods of manufacture may be entirely obviated by the adoption of Cornell's method. The machine used in the first experiment was in its common working order, the lead used

being that melted at the time for their market pipe, and the result was in quantity, as shown, enormously in favor of Cornell's method.

Tateham alleges an infringement of patent on the part of Cornell in the use by the latter of the hollow piston.

In our opinion, the ground he takes is entirely untenable. Tateham in his patent, claims the hollow piston *for the purpose, and used in the manner specified and described by him.* That is the true meaning of his claim for the hollow piston; for he cannot claim the use of the latter in general, it having been used by Watt himself. The hollow piston is used by Tateham, to enable him to *strengthen and stiffen the mandril or core.* It is used by Cornell, merely to carry off his pipe after it has been made. The principles of action of the two machines are totally different, and such we apprehend would be the decision of any mechanic, after witnessing their action. EDITOR.

ALFRED VINCENT NEWTON, FOR IMPROVEMENTS IN THE PRODUCTION OF GASES, TO BE USED FOR LIGHTING, HEATING, AND MOTIVE POWER PURPOSES. *Patent dated June 12th, 1850. Enrolled December 12th, 1850.*

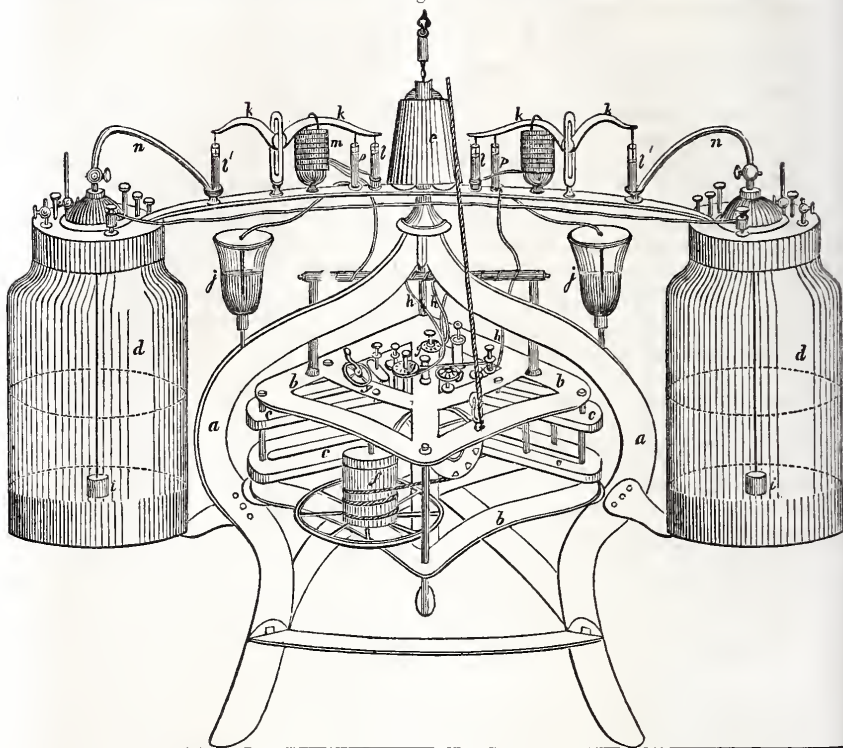
(PAINE'S LIGHT.)

THIS invention is for decomposing water, by means of electricity, and producing therefrom a gas, which after being made to pass through spirits of turpentine, or other hydro-carbonous fluids, will, when ignited, burn with great brilliancy. The invention is known by the name of "Paine's Light,"—this being, in fact, Mr. Paine's specification, in which he states, that although water has been spoken of as decomposed by the electric currents, he wishes it to be understood, that this is merely to accord with the general received chemical doctrines and phraseology, and that water, after all, may be a simple element; however that may be, the patentee wishes at present, to lay it down as certain, that by discharging electricity through water, as will be hereafter described, large quantities of gases are evolved; and that one of such gases, at least, when passed through turpentine, in the manner hereafter to be described, will burn and give a highly illuminating light.

He claims as follows:—"1st. The use of helices, in which are hollow helical coils, to be filled at pleasure, either with water or other electrical absorbent. 2dly. The use and construction of the electrodes, as above described. (Of platinum.) 3dly. The mode of applying electricity to the decomposition of fluids, by pulsations or intermittent discharges. 4thly. The construction and use of governors, for regulating the electric current, as described. 5thly. The method of catalyzing or rendering hydrogen gas luminiferous, by passing it through spirits of turpentine, or other hydrocarbon, at ordinary temperatures. 6thly. The use of non-conducting pipes, and isolated gasometers, for the purpose of conveying and holding the gases, for the purpose of this invention."

It will be seen that the machine here shown, is double, both sides being alike; *a*, is the frame on which the whole of the machine stands; *b*, *b*, is an inside frame, for supporting the permanent magnets, *c*, *c*; *d*, *d*, are the water jars; *e*, is a weight passing over a pulley, and terminating on the barrel, *f*, which is connected to the helices by means of gearing. The falling of the weight, *e*, causes the barrel, *f*, to turn, and with it the helices; *g*, *g*, are the discharging wheels, the edges of which are covered with some good non-conducting substance, with the exception of a point on their circumference, which is a good conductor. These discharging wheels are, by means of a spring, made to bear hard on the discharging rings, on the spindle of the helices; the conducting wires, *h*, *h*, are made to start from the spring-arm, which is insulated. The advantage of this arrangement is, that no discharge from the helices can take place, until such time as the non-insulated point on the circumference of the discharging wheels, comes in contact with the discharging ring on the helix spindle, and, consequently, as the different diameters of the ring and wheel are proportionate, so will be the accumulation of the discharges; *i*, *i*, are the electrodes; *j*, *j*, the vessels containing the turpentine. These should be constructed of some non-conducting substance, and the height of the column of hydro-carbon, should be nearly equal to the height of the column of water round the gasometer, so that the hydro-

Fig. 1.



gen shall not pass through too rapidly, for by doing so, the luminiferous or catalysing process would not be thoroughly effected. To accomplish this purpose, a mechanical means is adopted, to prevent in some measure, the current of gas, and cause it to bubble up through the liquid, by attaching a cotton wick, or the hollow wick of an argand burner, to the end of the tube introduced into the turpentine, or again to perforate the end of this tube with small holes, through which the gas has to force its way, being subjected in doing so to the friction due to so many holes. The gas in passing through these is divided into a number of small globules, thereby bringing a greater amount of surface in contact with the turpentine. The pipes which lead from the decomposing tank to the hydro-carbon, should be made of non-conducting materials, or be coated with insulating substances,

such for instance, as sealing-wax, whereby great brilliancy of light is obtained. The hydrogen should therefore be conveyed through such pipes from the decomposing cells, as soon as possible to the hydro-carbon, and afterwards collected in proper receptacles. These should be insulated, or composed of insulating materials. The pipes to conduct the gas to the point of consumption, should also be composed of non-conducting materials, as well as the vessel for holding the turpentine, as before mentioned,—for it is highly essential that the hydrogen should come in contact with the hydro-carbon, while this is in a highly electrified state. The governor before mentioned, consists of a beam, *k*, working on a suitable centre; to this beam a platinum bar is connected, sliding in the insulated mercurial cylinder, *z*, which the conductors, *h*, *h'*, connect with the helices,

Fig. 2.

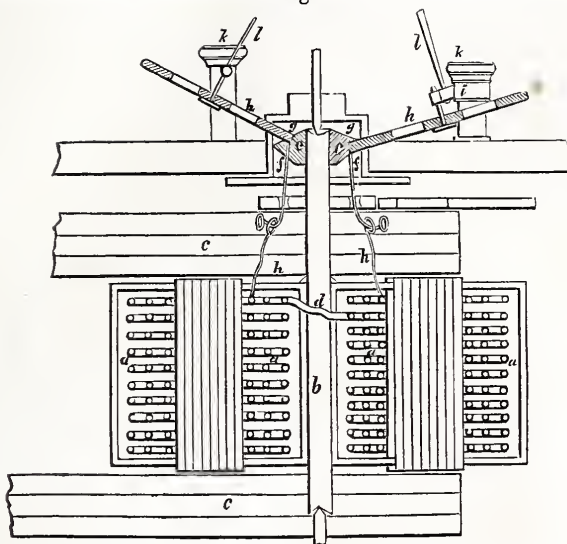


Fig. 3.

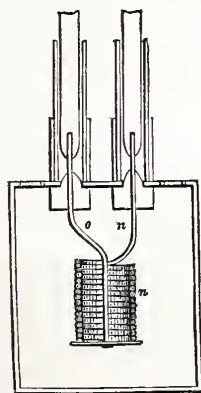
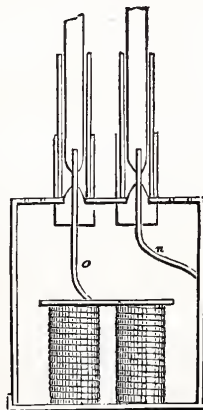


Fig. 4.



and the electro-magnet, *m*. The other end of the beam is also connected in a similar manner to the mercurial cylinder, *l*, from which proceeds the conductor, *n*, *n*, to the electrodes in the jar of water to be decomposed. Directly over the electro-magnet, *m*, is an armature, *o*. As the current is passed round the magnet, *m*, there will be a continued force acting on the armature, *o*, and to the beam on which it is attached. The action of this force may be regulated by a spring of sufficient

force, bearing on the top of the beam, or by any other convenient means. The beam is so adjusted, that the power of the spring balances the power of the magnet; and it may sometimes happen, that the power of the latter is increased, the beam being drawn down; the platinum bar in the mercury is also drawn out, thereby destroying the connection, which remains broken, until the power of the magnet decreases. The current being thus suddenly destroyed, a partial va-

vacuum is formed, and the mercury flies out and is thus lost. To prevent this occurrence, an additional mercurial cylinder, *p*, is fixed, as shown, the beam having a platinum bar similar to the other cylinders. In this the mercury is so gauged, that the bar shall enter the mercury before the other leaves it, thus turning the current into the cylinder, from which it is conveyed to the earth by a proper conductor.

In the helices the ordinary form is preserved, but an insulated tube, or hollow coil of copper wire, or other good conducting substance, is substituted for the ordinary helical coil, and this tube is filled with water, or other electrical absorbent. This arrangement has not only the advantage of giving the increased surface of the inside and outside of the coil to the action of the electric current, but also allows an accumulation to take place, the excess being absorbed by the water, where it will be retained until relieved by the dischargers. The coils, which must be insulated externally, may be made of gutta-percha, and filled with water; there being inside them a proper metallic wire, they, in fact, may be constructed of any metal which does not oxidate or corrode.

The patentee says, that when electricity is used for decomposing water, in a continuous current, it has been found unsuccessful in doing so in sufficient quantities, and at a cost moderate enough to allow of the products being applied to ordinary purposes. He has found, however, that if the current of electricity be made to enter the water, in a series of pulsations or discharges, great quantities of gas will be thereby evolved, at a cheap rate of cost.

Fig. 2 is a cross section of the helices; *a, a*, are the helical copper tubes, surrounding the centres or cores, which may be made of soft iron tubes, filled with water, as are also the helical coils. These are attached to, and revolve with the spindle, *b*, set in motion by clock-work, or any other simple means. Between the poles of the permanent magnets, *c, c*, the coils are joined, as shown at *d*; on the spindle, *b*, is the insulated cap, *e*, on which are the rings, *f*, and *g*, each insulated from each other, and joined to the helical coils by *h, h*. The rod which connects the rings on the spindle to the helical coils should be split its entire

length, in order that in entering the coil, fluid may be conveyed towards the rings, and the electricity to enter the water; *h, h*, are the discharging wheels, the periphery of which, with the exception of one point, is covered with some non-conducting substance, and made to bear on the rings *g* and *f*, by means of a spring, *i, i*, fixed to *k, k*, both of which are insulated; *l, l*, are the conductors. The helices will therefore only discharge once in the revolution of the discharging wheels, *h, h*, or when the good conducting points on the wheels are in contact with the rings *g* and *f*, on the spindle. Fig. 3 is a sketch of the improved electrodes, the principle being to conduct the current on large, free conductors, which terminate in a number of radial points; *m*, is the negative pole; *o*, the positive. The bottom of the cell is pierced with a hole, about one-sixth of its diameter, and the top is also pierced with a number of small holes, as shown. The conductors are to be insulated by being passed through a glass tube, or by being coated with some non-conducting surface. The electrodes should be made of fine platinum. Fig. 4 shows a modification of the above. Here the negative pole is fixed to the side of the cell, and the positive pole to a piece of copper, as shown. The bottom of this cell is also composed of copper.

GWYNNE'S IMPROVEMENTS IN OBTAINING MOTIVE POWER.

We copy the following from the London Patent Journal.

We have long been of opinion that water-power, so economical and accessible, has not been employed in this country to the extent it might be, and with the full advantages which should be derived from it. For hitherto, the immense power to be gained from tidal rivers has, in a great measure, been neglected, and manufacturers have contented themselves with deriving water-power from the old-fashioned undershot, breast, or overshot wheels, in inland streams or rivulets. It would be superfluous to dilate upon the extent of the power to be derived from the judicious employment of the ebb and flow of tidal rivers, or from the rise and fall of the tide on the sea-coast; nevertheless, the fact is clear, that this power is *not* adequately employed.

Fig. 1.

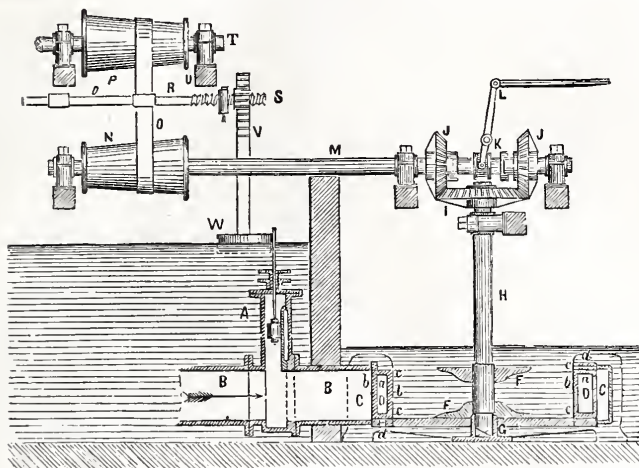
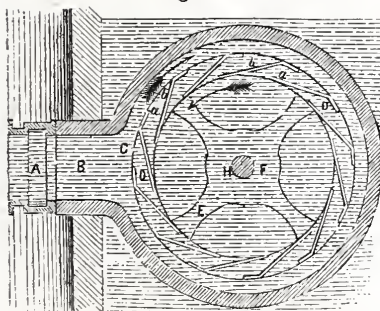


Fig. 2.



The reason, perhaps, for this may be found in the inefficiency of the mechanical means ordinarily used for obtaining hydraulic power; and if we can draw the attention of persons who may need motive power, to improved means of obtaining it from water, and thereby enable them to take full advantage of the sea, river, or stream, at their doors, we may do a service to a numerous class of our readers. The specification of the patent of Mr. JOHN GWYNNE, reported in this number, contains the development of much improvement in the water-wheel or turbine. His wheel would appear to be more especially adapted for use in tidal rivers, from the circumstance that, by his arrangements, the ebb and flow of the water are made to act with equal force

upon the wheel. For it may be changed readily, without using any complicated machinery, so as to meet the course of the water, a simple clutch-box being alone necessary for this purpose. Another great advantage, as we take it, to be found in the use of this wheel, is the complete economy of power resulting from it,—for every drop of water (so to speak) is made to contribute its quota of force to the machine. We are informed, that an average of power, taken from several wheels working under some disadvantages, gave 87 per cent. upon the whole *theoretical* power of the water.

The improvement described in this specification consists of a peculiar modification of that form of water wheel, known as the re-acting or turbine wheel, adapted to either a constant or graduating head of water, and is particularly applicable to tide-water purposes, whereby the wheel will work with the tide ascending a river or inlet of the sea, or under a graduated head of water, with the tide descending and going back into the sea. A mode of regulating the variable velocity of the wheel, so that the machinery driven by it shall always work at the same velocity, is also described in connection with the apparatus. In the engravings, fig. 1 represents a sectional elevation of the wheel and apparatus, with the water passing through the wheel; fig. 2 is a sectional plan of the wheel. A, the sluice valve: B, the water-

way or pipe communicating to the annular space *c*, around the wheel; *d*, the bucket or partition between each space, for the ingress or egress of the water to work the wheel either way of the tide; *e*, *e*, the arms; *f*, the boss or centre of the wheel; *g*, the step which is cast into the bottom, and forms part of the annular casing; *h*, is the vertical shaft, carrying at its upper end a bevel wheel, *i*, working into two bevel pinions, *j* *j*; *k*, is an ordinary clutch box, which is shifted from right to left, by means of the handle, *l*, for reversing the motion of the driving shaft, *m*, when the tide turns; *n*, is a cone pulley, on the end of the driving shaft, having a belt, *o*, passing round it and over the driven cone pulley, *p*, which is fastened on the shaft in the mill or manufactory, from which the machinery is driven. *q*, is a horizontal rod, with a cotter hole in it, through which the belt passes; it is screwed from the points, *r* to *s*; *t*, is a pillow block or bearing, in which revolves the screwed box to receive the screwed end of the rod; affixed to the box is a pinion, *u*, which is moved round right or left by the vertical action of the rack, *v*, up or down; the rack having affixed to its lower end a float, *w*, so that as the tide rises or falls, more or less head of water is given. The difference of motion, from fast to slow, or from slow to fast, is compensated for by means of the belt traversing from right to left, from the large diameter to the small, and left to right, from the small diameter to the larger of the pulleys. The peculiar features of this wheel, and the principal improvements from any other of its class, consist in the shape of the partitions between each water way, presenting a direct surface to be acted upon by the water, in its passage through the wheel, whether the water passes into the dam through the wheel, or from the dam to the river. The annular space, *a*, *a*, that contains the partitions, or buckets, *b*, *b*, is cased at top and bottom, as represented, and marked, *c*, *c*, both surfaces of which are turned perfectly true in the lathe; these surfaces work upon the lower, and under the upper surface of the annular casing at *d*, *d*, but not in such contact as to cause much friction, thereby directing the water through the water ways between each partition. The advantage of this form of bucket or partition is, that it presents a more direct, and

greater area of surface to the action of the water, in its passage through the wheel, whether the water be going into or out of the dam. The direction in which the wheel moves is shown by the arrows in the plan.

The patentee claims—

The obtaining and applying motive power, by means of a wheel, having buckets, consisting of two curvilinear portions, connected by one rectilinear portion, arranged about a circle, within an annular casing, as described.

JORDAN'S PATENT SYSTEM OF SHIPBUILDING.

We lay before our readers, from the *Civil Engineer and Architect's Journal*, the description of Mr. Jordan's invention in his own words:—

Specification.

My invention consists—1st. In the combination of an iron frame, with an external covering of timber planking for the sides, bilges, and bottoms.—2d. In a peculiar manner of making the butt joints of the external covering of timber planking.—3d. In the construction of an iron frame with a timber keel.—4th. In the combination of an iron frame with a timber stem.—5th. In the combination of an iron frame with a timber stern-post.—6th. In a peculiar manner of constructing an iron frame, adapted to a covering of wood for the sides, bilges, and bottoms, and combining with the frame a timber stem, a timber keel, and a timber stern-post.—7th. In a peculiar manner of constructing the keel-plate, the stem-plate, and the stern-plate.—8th.—In a peculiar manner of constructing the keelson or keelsons.—9th. In a peculiar manner of constructing the vertical and horizontal stringers.—10th. In the application of rolled iron of a bridge-form, similar to a "bridge-rail," as ribs, in the construction of the iron frame of vessels navigating on water, built of iron, or iron and timber combined.—11th. In coating the bottoms of vessels navigating on water with a mixture of gutta percha and blacklead, and also such parts as are made of iron.

First. A suitable iron frame is to be constructed, to which an external covering of timber planking for the sides, bilges, and bottom, is to be fastened by

Fig. 1.

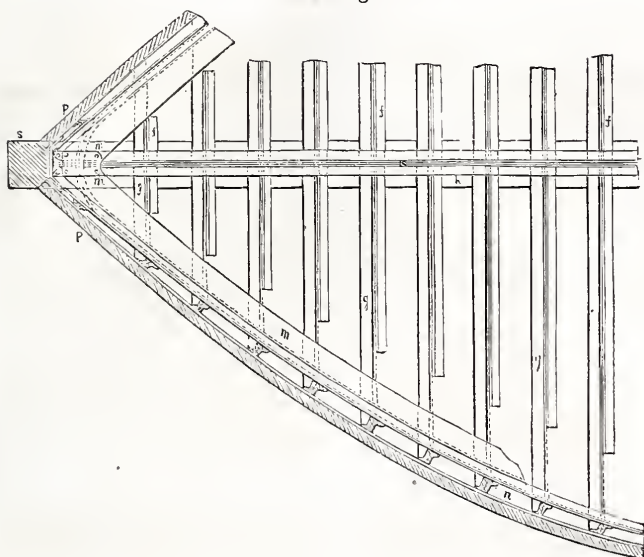


Fig 4.

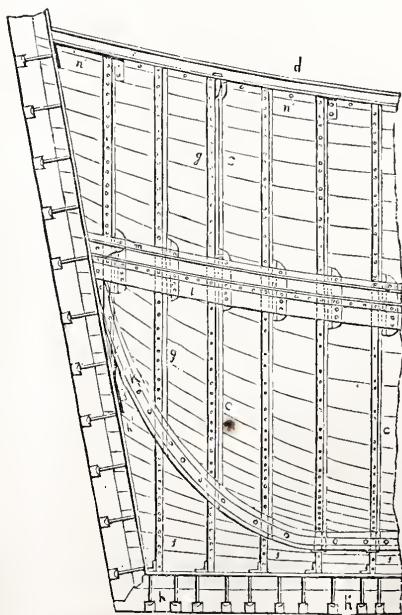


Fig. 2.

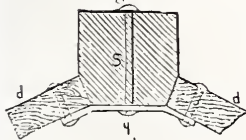


Fig. 5.

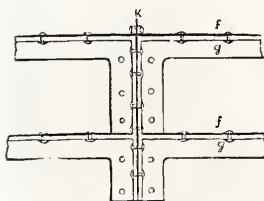
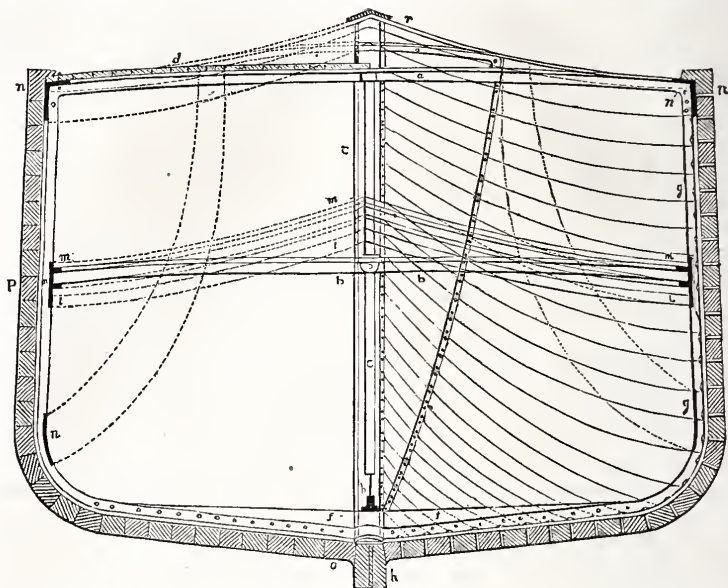


Fig. 3.



means of rivets, bolts, or any known or suitable fastening. The vessel may have one or more thickness of timber planking, and may be sheathed with copper and felt, or zinc and felt, or galvanized metal and felt, for the purpose of keeping the bottom of the vessel from fouling.

Second. I make the butt-ends of the timber planking with an iron plate placed inside to cover the vertical joints, the iron plate being of sufficient length and thickness to be fastened to the ends of the abutting planks; and between the timber planking and the iron plate, I pass a thickness or layer of felt, gutta percha, or india-rubber. In this manner I add strength to the planking, and at the same time make a water-tight joint. The horizontal joints or seams between the planks are to be calked in the usual manner in which the planks of timber-built vessels are usually calked—viz., with oakum.

Third. I make an iron plate, of any suitable form, run the whole length of the bottom of the vessel, to which is to be fastened a keel made of timber, with bolts or rivets, or any other suitable fastening.

Fourth and Fifth. I cause the iron

plate forming the keel-plate to be continued up the bow of the vessel, and also up the stern of the vessel, to which I fasten a stem made of timber at the bow; and at the stern I fasten a stern-post made of timber, by means of bolts, rivets, or any suitable fastening.

Sixth. I make an iron plate form the keel-plate, laid the whole length of the bottom of the vessel, and continued up the stem and stern. To this plate I fasten the keel, stem, and stern-post, made of timber as just described. The plate is to be bent so as to form an apron or holding for the ends of the external planking of the sides, bilges, and bottom; across the keel-plate, iron ribs are to be fastened, and floorings of iron are to be fastened to the iron ribs. On the top of the floorings I place the keelson, made with plate and angle-iron, or rolled iron, and fastened to each floor. At each extremity of the vessel the keelson is made to assume a curvilinear form, or portion of an inverted arch, to keep the ends of the vessel from drooping. The deck beams, both upper and lower, will be placed and fastened in the manner usually adopted in iron-built vessels, that is to say, fastened

to the sides; and, if necessary, where convenient, to the ribs. In the wake of the upper and lower deck beams, I place on the outside of the ribs stringers of plate-iron, or plate-iron binding-strakes all round the vessel, and fasten the same to each rib, and also to the stem-plate or apron forward, and to the stern-plate aft the vessel; the ends of the deck beams are fastened to these stringers. There will also be stringers on the top of the ends of the beams lying horizontally, fastened to each rib, to each beam, and, if necessary, to the stringers outside of the ribs. There may be also other stringers introduced inside the ribs if necessary.

Seventh and Eighth. The keelson or keelsons may also be constructed in the following manner:—On the top of the keel-plate before described, the keelson will be placed; and the ribs will abut and be fastened to the keelson, and also to the keel-plate. The floorings will abut and be fastened to the keelson, and in the usual manner to the ribs.

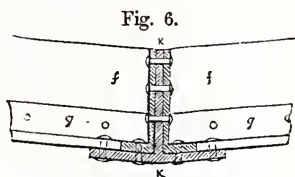
Ninth. I place vertical stringers outside the ribs, fastened to each rib, and to the ends of the beams; and also, if necessary, to the horizontal stringers, as before described in the description of the frame.

Tenth. I apply rolled iron, of the bridge form, similar to a bridge-rail, in the construction of the iron frame of vessels navigating on water, built of iron, or iron and timber combined. The iron plates, or timber planking, may be fastened by any known means to the flanges of the bridge-rib, or the bridge-rib may be reversed, and the iron plates or timber planking fastened by any known means to the top of the bridge-rib, and the ceiling or linings fastened to the two flanges of the bridge-rib. By this mode of construction, the whole of the iron work will form a complete frame, to which the woodwork will be attached.

Eleventh. I apply a mixture of gutta percha and black lead for coating the bottoms of vessels, either of wood or iron, to prevent fouling; and also for coating such other parts as are made of iron, to prevent corrosion. The gutta percha is to be dissolved in spirits of turpentine, naphtha, or any other solvent; and the black lead is to be mixed with the solution, to any consistency required, and applied hot.

References to Engravings.

Fig. 1 is a plan of part of a vessel. Fig. 2 is a section of the timber stem or stern-post, showing also the section of the iron apron to which the ends of the planks, the ends of the iron stringers, and the wood stem or stern-post are fastened. Fig. 3 is a transverse section of a vessel with part of the deck removed, showing the midship frame. Fig. 4 is a longitudinal section of one end of a vessel. Fig. 6 is a section, and fig. 5 is a plan, showing a second method of constructing the keel-



son, ribs, and floorings: *a*, upper deck beams; *b*, lower deck beams; *c*, stanchions; *d*, deck; *f*, iron-plate floorings; *g*, iron ribs; *h*, timber keel; *h'*, keel-plate; *k*, iron keelson; *l*, vertical iron plate stringer under hold-beams; *m*, horizontal plate stringer above hold-beams; *n*, iron plate binding-strake or stringers outside the ribs; *n'*, upper iron plate binding-strake or stringer outside the ribs; *o*, garboard strake; *p*, timber planking of the sides.

The *Marion Macintyre* is 300 tons burden; her actual weight, hull, masts, spars, and every thing, does not weigh more than 100 tons. The owners have, therefore, the means of putting 100 tons additional into her, and letting her sail as fast as other vessels. With thirty or forty tons of ballast on board, she did not draw more than 4½ feet of water. If a cargo of more than double her average capacity was put in, she would not probably draw more than 12 or 13 feet of water. Her model is a very beautiful one. She possesses all the requisites for speed, and is fitted up with every recent improvement. Her dimensions are as follow:—Length 117 feet, breadth of beam 22 ft. 5 in., depth of hold 15 ft. 6 in. She is intended for the African trade.

This is the second vessel to which a principle patented by Mr. Jordan has been adapted, a principle which, if it realize the anticipations of those best competent to

judge of its merits, will, in a very short time, effect a revolution in the ship-building trade of this country. It consists of a combination of iron and wood, the framework of the vessel consisting of iron, the covering being, as usual in wooden-built ships, of timber. The advantages to be derived from this combination are, strength to any amount required without the vessel being rendered unwieldy, a lightness of draft unattainable in timber-built vessels, whilst the possibility of dry rot is altogether obviated, which is in itself a great desideratum. The carrying capacity of vessels constructed on this principle is very great. This must be obvious when we consider how much less space the iron framework occupies, and the increased carrying power which is thus realized. At first it was apprehended that it would be difficult to copper vessels built on this principle, so as to prevent galvanic action taking place, occasioned by the proximity of the iron and copper. The introduction of layers of gutta percha has removed this difficulty, and there is nothing to prevent a full and fair trial of this important invention.

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MESSRS. ROSENBERG AND MONTGOMERY'S
PATENT CASK-MAKING MACHINERY.

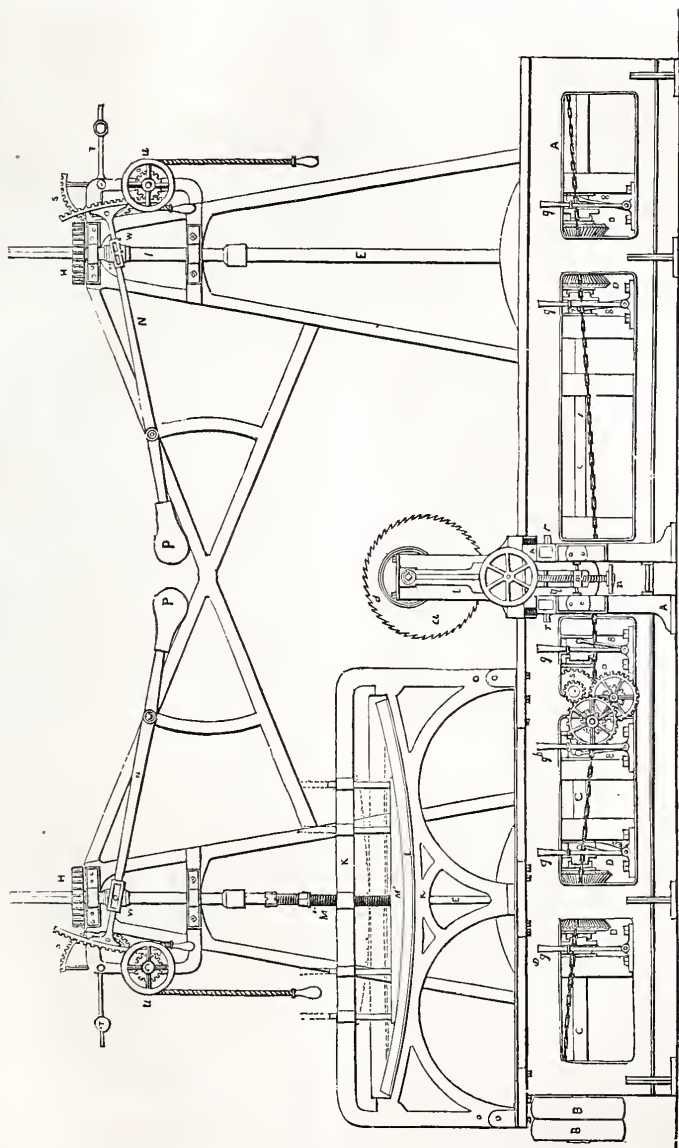
We take the following from the London Mechanics' Magazine :—

The Patent of Messrs. Rosenberg and Montgomery comprehends a number of processes or mechanical arrangements relating to cask-making, all of which are more or less new and valuable. First, there is a method of sawing wood into pieces or blanks suitable for staves; second, a method of converting these blanks into staves; third, one for combining the staves into casks; and fourth, an apparatus for drilling the holes or sockets in the heads of casks for the reception of the dowels necessary for keeping the parts together. It is the machine comprehended under the second of these heads which has particularly struck us for its ingenuity, and which we here propose to describe. A simple statement of the problem of which it is the practical solution, will suffice to convey to the reader a clear idea of the difficulties which the inventors had to overcome. The problem was this:—To take any given number of

flat rectangular staves, and so shape the whole at one operation that when built up together into a cask, they shall every one have the exact bevel, bulge, and taper which is requisite for the formation of the cask. The new machinery by which Messrs. Rosenberg and Montgomery have accomplished this rare combination of difficult achievements is represented in the accompanying engravings, of which the following is their own description :—

Fig. 1 represents a front elevation, fig. 2 a back elevation, fig. 3 an end view, and fig. 4 a cross section of this machine. *A* is the framework; *B B* the loose and fast-driving pulleys on the main shaft *c*; *D D* bevel wheels which run loose on the shaft; *E E* vertical shafts which revolve at right angles to the main shaft *c*, and are put in motion by bevel wheels *F F*. *G* and *H* are spur wheels which communicate motion to the vertical shafts *I I* at the front of the machine; *K* is a frame which slides on the framework *A*, and carries the blank which is to be formed into a stave. *M*¹ is a pressing block, which is made of a convex form on its under surface, corresponding exactly with the interior curve of the intended stave. *M*² is a screw which is passed through the top bar of the frame *K*, and acts upon the block *M*¹; *N* is a lever centred at *n*, which has a toothed segment *o* on one end, and a counter weight *P* on the other. *Q* is a pinion which works into the toothed segment *o*; *R* (see fig. 3, the end view of the machine) is another pinion on the same shaft as *Q*, which works into another toothed segment *s*, and thereby gives motion to the tumbler *T*. *U* is a cord wheel, by means of which motion is given to the toothed segment *o* and lever *N*, and also to the tumbler *T*. *V* is a loose socket on the vertical shaft *I*, which socket is kept in its place by means of two collars *W W*, and has two pins projecting from it at right angles, which work through slots in the eye-piece *X* of the lever *N*, which eye-piece fits on to the shaft *I*. *Y* is a drum which carries the chain *Z* over the rollers *1*, and being fastened to the sliding frame *K*, gives motion to the same. The chain drum *Y* receives its motion through the bevel wheel *2*, which works into the bevel wheels *D*¹ *D*¹ on the main shaft *c*; on the other end of the shaft which carries the bevel wheel *2* is a pinion *3*, which works into the spur wheel *4*, to which

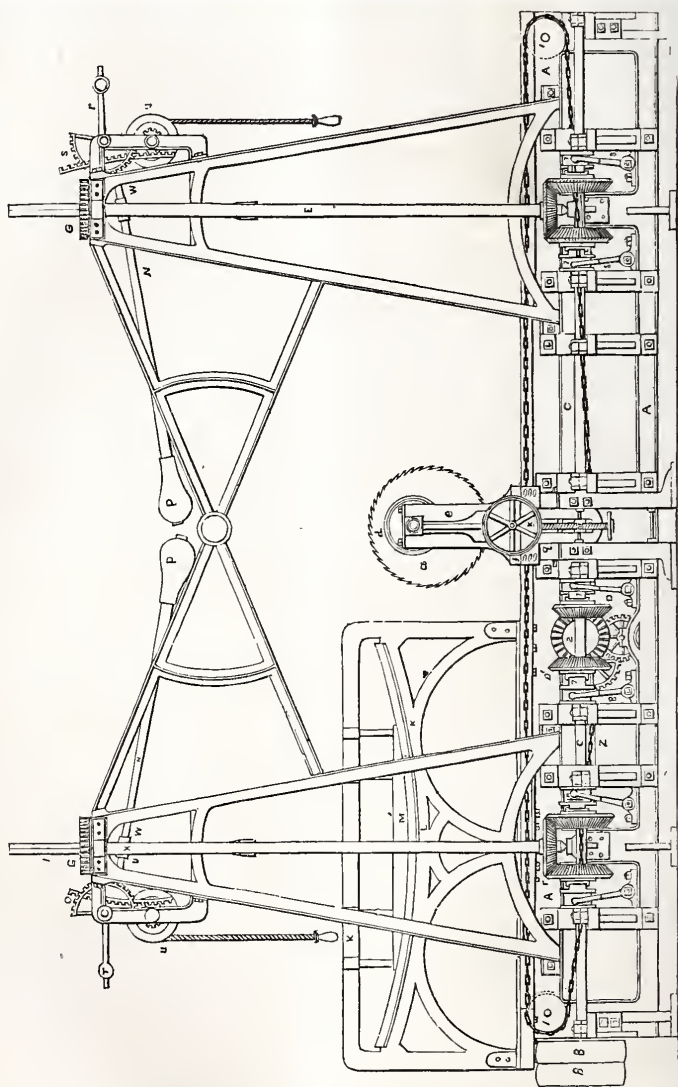
Fig. 1.



spur wheel is attached the pinion 5, which works into the spur wheel 6 on the shaft of the chain drum x. 7 7 are clutch-boxes which slide on keys on the main shaft c, and are worked by forked levers 8 8, which again are actuated by the handles

9 9, as seen in the front view of the machine, fig. 1. *a a* are circular saws which are fixed to the shafts *b b*, to which shafts motion is given by the strap pulleys; *c d* are loose strap pulleys on the same shafts *b b*. The shafts *b b* are mounted in frames

Fig. 2.



ee, which are made to slide on the plates *f* by means of *v*champs; *gg* are screws by which sliding motion is given to the frames *e*, the screws working in the nuts *h* affixed to the frames *ee*. The spindles of the screws *gg* are mounted on the plates *ff*, and carry at their outer ends hand wheels *ii*; *kk* are swivel joints fas-

tened underneath the plates *ff*; *ll* are screws, the upper and plain ends of which work into the swivels *kk*, and are so kept in their places by means of pins which fit into circular grooves cut in the ends thereof. The screws *ll* are also tapped through a swivel nut *m*, which has its bearings in plummer blocks attached to

Fig. 3.

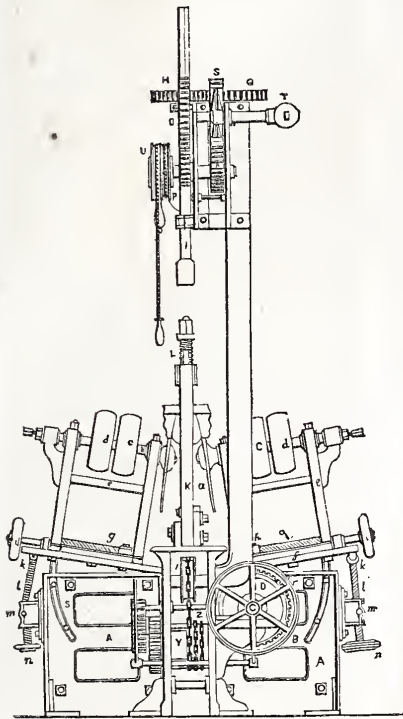
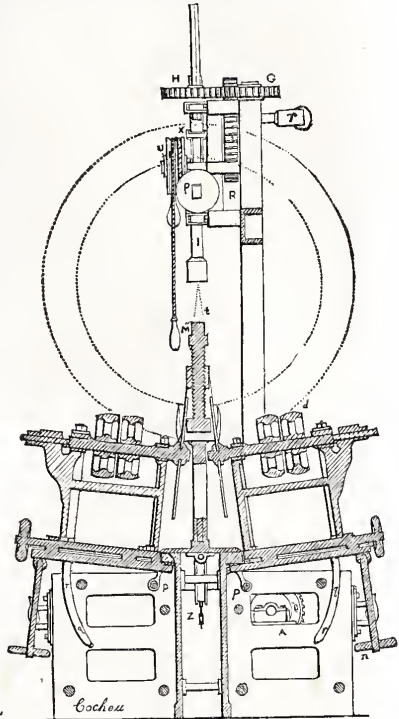


Fig. 4.



the frame A, and have hand wheels *nn* at their lower ends. The plates *ff* have lugs *o o* fastened on their inner ends, which lugs work upon shafts *pp*, and so form centres for the circular motion of the plates *ff*. The plates *ff* are provided also underneath with guides *qq*, which work tight in the framework A. The guides *qq* have two screws *rr* tapped into them on each side, which work through slots *ss* in the framework A. The machine is worked in the following manner:—

The sliding-frame *k* being placed at one end of the machine, so that the screw *m*² is in the same vertical line with the shaft *i*, the pressing block *m*¹ being raised close under the top of the frame *k* (see dotted lines in fig. 1), the blank required to be shaped into a stave is placed in the frame *k*. The handle *9*^a is moved towards the left, so as to couple the clutch-box 7 with one of the bevel wheels

D. Motion being communicated to the vertical shaft *i*, in the front of the machine the man takes hold of the cord-handle nearest to the shaft *i*, and turns the cord-wheel *v*. By doing so, the vertical shaft *i* will be lowered down upon the square part of the screw *m*² (the socket of the vertical shaft *i* fitting over the square top of the screw), and the tumbler *t* being moved over to the other side, will keep the shaft *i* close upon the screw *m*². The screw will now turn round, and thereby bring the pressing-block *m*¹ down upon the blank piece of wood, and by the motion being continued will press it down in a curved position close against the bed of the frame *k*. The wood will now have the shape given to it which it is required to possess when put into its place as a stave in the formation of a cask. When the blank has thus been bent, the same handle *9*^a is moved towards the right, whereby the clutch-box 7 is disen-

gaged from the bevel-wheel *d*. The motion of the screw is thus stopped, and the workman, by taking hold of the corded handle farthest from the shaft *i*, causes the cord-wheel *u* to turn round, by means of the shaft *i* is disengaged from the screw *m*², and raised to its former position. The workman now takes hold of the handle *g*^h, which couples the chain motion, and by moving that handle so as to bring the corresponding clutch-box into gear, the chain drum *x* will turn round, by means of which the slide *k* will be put in motion. The circular saws *a a*, being always in motion when this machine is at work, the blank will now be brought into contact with them, and both the sides of the blank will thereby be cut as the slide continues to move between the saws *a a*. When the slide *k* arrives at the other end of the machine, the handle *g*^h, for the chain-coupling is moved by the workman, so as to detach the clutch-box from the bevel-wheel *d*, and thereby stop the motion of the slide, which will now be in the same position at this end of the machine as it was before at the other end, that is to say, the screw *m*² will be in the same line with the vertical shaft *i* at this end of the machine. One of the handles *g*^c is now moved by the workman putting the shaft *i* at this end of the machine in motion in the reverse direction, which being done, the workman takes hold of the corded handle nearest to the shaft *i*, and by twining round the cord-wheel *u*, causes the shaft *i* to descend upon the screw *m*², and thereby puts that screw in motion, which causes the pressing block *m*¹ to rise up under the top of the frame *k*. The workman now stops the motion of the shaft *i*, but he does not disengage that shaft from the screw *m*². The stave, being now completed, is removed from the frame *k*, a fresh blank put in, and the preceding operation repeated, but in the reverse direction of the machine. In order to enable the workman to vary the width of the cut staves, and also to enable him to alter the position of the saws to cut the various bevels required for different-sized casks, the saws are adjusted in the following manner:—Having determined upon the required width of the stave, he moves the hand-wheels *i i*, and by means of the screw *g g*, adjusts the frames *e e*, and the saws *a a*, to the requisite dis-

tance from the central line of the framework *k*. Having done this, he moves round the hand-wheels *n n*, on the screws *l l*, and thereby causes the outer ends of the plates *f f* to rise or fall, in order to place the saws *a a* in a position to form the radii, or nearly so, of the circle of the cask to be made (see the dotted lines *l l*, fig. 4). He now tightens the bolts *r r* on both sides of the guides *q q*, outside the frame *A*, whereby the angular position of the plates *f f* is secured. With such modifications as will readily suggest themselves to a competent workman, the blank in its longitudinally curved state may be submitted to a circular-saw bench, to a planing or other cutting machine, or to suitable cutting tools, in order to produce a stave with the bevel bulge and taper requisite for its formation into a cask; a stave may thus be formed either by machine or hand-power, and one or both sides may be completed in one operation.

The improved machinery of Messrs. Rosenberg and Montgomery has not been as yet many months in operation, but already a very considerable number of casks of nearly all descriptions have been manufactured by them; viz., oil-butts for the fisheries, water-butts for emigrants, rum puncheons, sherry pipes, hogsheads and quarter-casks, beer hogsheads, and barrels for exportation and inland trade, spirit puncheons, &c. &c. Of these, some have been sent to the Hudson Bay Company's settlements, some to Spain, to the West Indies, to the coast of Africa, to the East Indies, to Australia, and to New Zealand.

All these casks have given the utmost satisfaction, with the exception of a very few of those first put together, before the machinery was in perfect working order. Certainly casks cannot be made by hand to equal those we saw turned out the other day. The mathematical correctness with which the staves are shaped (or "jointed," as the coopers call it), by these machines, gives much greater strength and tightness to the casks than we ever witnessed before. The hand-cooper's *art*, in giving form to the stave, is a very difficult one, and requires long practice. He works entirely by measure of the eye; but however well instructed he may have been—however expert he may have been in hitting angles—still he cuts away

to a certain extent at random, and it is therefore impossible that he can attain to that accuracy which is necessary to make a stave a *perfect part of a cask*. Besides, casks of different shapes and sizes require staves of different forms, depending upon the greater or lesser "bilge" and length, by which the curvature of the lines of the staves must be determined. Another most difficult and important matter to be attended to is the *bevelling of the edges*. As the cask varies in diameter from the middle or highest point of the bilge to the end or "head," so must the bevel of the edges of each stave vary accordingly, in order to produce a good or "tight joint," or to make the stave fit well in its place. It is no doubt this latter circumstance which has presented to inventors hitherto, the principal difficulty in the way of constructing machines for jointing staves. By the machinery of Messrs. Rosenberg and Montgomery, the curvature of the lines, as well as the varied bevel of the edges, are given to the staves with unerring correctness, whatever may be the shapes and sizes of the casks.

We are not in possession of sufficient data to form an accurate estimate of the economy attending the use of this machinery; but one fact bearing on this point we may mention. A principal jointing machine of an average size, or adjusted for making hogsheads, with the attendance of two boys, can joint sufficient staves for ninety hogsheads in one day of ten hours; which is, we understand, more than what can be done *regularly* by twenty-five experienced coopers.

NOTES ON THE U. S. STEAM FRIGATE "MISSISSIPPI."

BY CHIEF ENGINEER B. F. ISHERWOOD U. S. N.

THE American government cannot be considered to have begun the building of a steam-navy until the construction in 1840 of the sister frigates "Mississippi" and "Missouri," which differed only in type of engine,—the former having the ordinary side lever with balance puppit valves, and the latter having a direct-action inclined engine. The "Missouri" had a short life, being burnt at Gibraltar on her first foreign cruise; the "Mississippi" has been kept in almost constant service up to this present, and is now

cruising in the Mediterranean. She has been altogether the most serviceable vessel in the navy, and the following notes on her will be found of value to those interested in steam navigation. Total cost of vessel \$550,254; of machinery alone, including wheels, bunkers, &c., \$243,571.

DIMENSIONS OF HULL.—Length 228½ ft. over all; length, between perpendiculars, 220 ft.; beam, 40 feet ex.; moulded, 39 ft.; depth of hold, 23½ ft.; displacement at mean draught of 18½ feet, 3,220 tons; launching weight of hull, 1280 tons; immersed amidship area, 684 sq. ft., at mean draught; deep load draught, 20 feet; draught, with every thing on board ready for sea, except coal, 17½ ft.; barque rigged, displacements at the following draughts of water:—

Draught in feet.	Displacement in tons.
10	1332.16
12	1723.68
14	2132.81
16	2556.52
18	2991.80

Amount of surface in plain sails, that is, to topgallants inclusive, 19,000 square feet; being nearly the same as for a sailing frigate.

ENGINES.—Two side lever engines. Diameter of cylinder, 75 inches; stroke of piston, 7 feet; space displacement of both pistons, 429.5 cubic feet; balance puppit steam and exhaust valves; upper steam and lower exhaust valves, 14½ inches diameter; lower steam and upper exhaust valves, 13½ inches diameter; lifting air pump, 46½ inches diameter; stroke of piston, 3½ ft.; space displacement of pistons of both air pumps, 86.5 cubic feet, or 20¼ per cent of that of the steam pistons; capacity of condensers, 150 cubic feet, or 35 per cent of the space displacement of the steam pistons; feed pumps (2 to each engine), 7½ inches diameter by 44 inches stroke. From the relative dimensions of the cylinder and cylinder valves it will be seen that there was one square inch of valve opening to 1162 cubic inches of steam piston displacement. Steam room, 1770 cubic feet; total weight of engines, 211 tons.

PADDLE-WHEELS.—Of the common radial kind, 28 feet diameter from outside to outside of paddles: length of paddle, 11 feet; breadth of ditto, 30 inches; split

between Oct. 1845, and March 1847, is as follows: Speed of vessel per hour, 7.06 knots; revolutions of the wheels per minute, 10.4; steam pressure in boiler above atmosphere per square inch, 10.5 pounds; cut off at 0.38 of the stroke from the beginning; consumption of coal per hour, 2877 pounds. Making the calculation for these figures as before, we obtain a total evaporation of 5.4 pounds of water per pound of coal per hour; being 13 per cent. more than the previous evaporation. To what is this difference owing? Manifestly to the proportions of the boiler. In the first instance, there was consumed on each square foot of fire grate per hour, 17.34 pounds of coal; in the second instance there was similarly consumed 11.07 pounds. Now if, owing to any cause, the proper quantity of atmospheric air be not presented to the coal, its full measure of caloric cannot be evolved, and in a steam boiler this quantity depends chiefly on the proportion of heating to grate surface, and on the *calorimeter*, that is, the area of the flues or conduits of the heated gases. The first affects the velocity of the draught by cooling down the gases, and, *ceteris paribus*, the greater this proportion the slower should be the draught. The second affects the velocity of the draught by determining the bulk of the heated gases passed off in a given instant of time for equal temperatures, and, *ceteris paribus*, the smaller the calorimeter proportionally to grate surface, the slower should be the draught. It will readily be seen now, that the larger the proportion between the heating and grate surfaces, the larger proportionally should be the calorimeter. Supposing these proportions to be in proper accord for the consumption of a given weight of fuel in a given time, it is obvious they will not be in accord for the consumption of any other weight in a given time.

If this weight be increased, the economical result will be decreased from two causes; first, there will not be sufficient heating surface to cool down the gases to the proper temperature; second, there will not be air enough admitted to evolve all the caloric of the fuel. If the weight be decreased, there will be admitted too much air, and a loss of economical effect would result from its cooling influence. In practice it will be found that

the calorimeters of steam boilers are entirely too small, as well as the proportion between heating and grate surface, to give the best economical results. From my own observations, I have no hesitation in saying that a proportion of heating to grate surface of 35 to 1, and a proportion of grate surface to calorimeter of 4 to 1, would give a consumption of about 10 pounds of bituminous coal with natural draught per square foot of grate per hour, with a very highly increased economical result, viz., about 8 pounds of water per pound of coal. In the boilers of the "Mississippi," the calorimeter at the bridge was 66.5 square feet, or a proportion of 3.91 square feet of grate to 1 square foot of calorimeter; but this proportion decreased rapidly, until, at one-third the length of the flue, the calorimeter became 44.7 square feet, or a proportion of 5.82 square feet of grate to 1 square foot of calorimeter, which must be taken as the proportion for this boiler. Now if a proportion of 35 square feet of heating surface to 1 square foot of grate surface should have a proportion of 4 square feet of grate to 1 square foot of calorimeter, a proportion of 25 square feet of heating surface to 1 square foot of grate surface should have a proportion of 5.6 square feet of grate to 1 square foot of calorimeter. This was nearly the actual proportion of the "Mississippi's" boilers; but then in those boilers the proportion of heating to grate surface being only 25 to 1, the temperature of the heated gases could not be sufficiently reduced, and they were consequently delivered into the chimney at an altogether too high temperature for economy: this temperature would furthermore greatly increase the draught, and consequently the weight of coal consumed in a given time per square foot of grate. In this manner the waste would become greater and greater the more the fires were forced, the increased consumption of fuel increasing the draught, and the thus increased draught again increasing the consumption of fuel,—the heating surface remaining the same. Thus we see, in the case of the "Mississippi's" boilers, that *increasing* the consumption of coal from 11.07 to 17.34 pounds per square foot of grate per hour, decreased the economical evaporation 13 per cent.; while a reduction in the consumption of coal below 11.07 lbs.

per hour was attended with an increased economical evaporation as shown in the following extract from the Log for 67 hours steaming on the 1st, 2d, and 3d of October, 1846, when with a wide throttle, and cutting off at $\frac{3}{10}$ of the stroke from the beginning, the steam pressure in boiler above atmosphere being 11.3 pounds per square inch, strokes of engine per minute 21, consumption of coal per hour 2421 pounds. Speed of vessel with a moderate aft breeze, and sail set to topsails, 7.45 knots per hour. The consumption of coal per hour per square foot of grate surface was then 9.31 lbs. The Indicator diagrams show the initial pressure in the cylinder under the above state of things to be 1 lb. less than in the boiler, and making the calculation as before, we find the total evaporation to be 6.41 lbs. of water by one pound of coal per hour. We perceive then that *decreasing* the consumption of coal from 11.07 to 9.31 pounds per square foot of grate per hour, *increased* the economical evaporation from 5.4 to 6.41, or $18\frac{7}{10}$ per cent. This is probably the maximum economical result that can be produced in boilers of these proportions.

It has been said that there could be too small a consumption of coal per square foot of grate for maximum economical result, in which case the prejudicing cause would be the admission of a greater quantity of air than was required for the combustion of the coal, reducing the evaporation by cooling down the heated surfaces. The log of the "Mississippi" furnishes a striking instance of this. During 48 hours' steaming on the 16th, 17th, and 18th March, 1847, when with the throttle $\frac{1}{2}$ open, and cutting off at $\frac{3}{10}$ of the stroke from the beginning, the steam pressure in boiler above atmosphere being a mean of 7.65 pounds, strokes of piston per minute 17.8, the consumption of coal per hour was 1720 pounds. Speed of vessel with a fresh aft breeze, and sail set to top-gallants, 8.21 knots. The consumption of coal per hour per square foot of grate was now 6.62 pounds. From Indicator diagrams taken under the above state of things, the mean of the total steam pressure in the cylinder for the space to which it is admitted before cutting off, is 14.7 pounds per square inch. Calculating the evaporation as before, we obtain a total

evaporation of only 4.48 pounds of water per pound of coal per hour.

Collecting the foregoing obtained results, we have for a copper boiler with 25 square feet of heating to one square foot of grate surface, and a calorimeter of 1 square foot of transverse area of flue or conduit to 5.82 square feet of grate, with a total height of column of draught of 63 feet from grate bars to top of smoke chimney:

Pounds of bituminous coal consumed per square foot of grate per hour, with natural draught.	Pounds of seawater evaporated per hour from a density of .0625 per pound of coal (inclusive of loss by blowing off).	Comparative economical results.
6.62	4.48	1.000
17.34	4.78	1.067
11.07	5.40	1.206
9.31	6.41	1.431

We thus see, that in the same boiler the economical evaporation can be varied 0.43 within the limits of practice by merely restricting the consumption of fuel per unit of grate to the amount normal to the calorimeter, and to the proportion between heating and grate surface. It is manifest, then, that in all steamers careful experiments should be performed with varying quantities of fuel, the economical evaporation obtained for each, and the consumption restricted (when practicable) to that which gives the highest result.

The foregoing general remarks on boilers are of course intended to apply to steam vessels, where the smoke pipes are limited to between 50 and 60 feet height above the grates. On land boilers, where the chimneys may be carried to comparatively great heights, a corresponding reduction of calorimeter can obviously be made with the same proportion of heating and grate surface; or can be retained with an increased proportion between heating and grate surface.

The boilers of the "Mississippi" were four in number, with three furnaces in each. Weight of boilers, chimney, connections, &c., 120 tons:—of water in boilers, 82 tons:—total, 202 tons. Total weight of engines, boilers, water in do., paddle wheels, bunkers, 23 tons:—stores of engine department, tools and spare pieces, 7 tons:—490 tons, to which add half of 600 tons of bituminous coal, carried in bunkers, and we have a grand total of 790 tons devoted to the engine

department at mean draught. Now the useful displacement of the vessel, that is, the displacement left at mean draught after deducting weight of hull, is 1940 tons; taking from this 790 tons appropriated for the engine department, there remain 1150 tons for the sparring, rigging, ammunition, battery, stores, personnel, &c., &c., of the vessel. The engine department occupying 69 per cent. of the available displacement.

The battery consists of two ten-inch (120 pounds) Paixhan guns, mounted one on each bow, on pivots, and eight eight-inch (68 pounds) Paixhan guns mounted abaft the wheels in broadside.

PERFORMANCE.—The mean performance of the "Mississippi," under steam alone, in the Atlantic and Gulf of Mexico, from Oct. 1845 to March, 1847, during

$26.81 \times 3.1416 \times 10.65 \times 60 = 53820.60$ feet = speed centre re-action per hour.

$6082\frac{2}{3} \times 7.335 = 44616.36$ feet = speed of vessel per hour.

9204.24 feet = slip of centre of re-action per hour;

or $17\frac{1}{10}$ per cent.; there being $3\frac{2}{3}$ paddles acting propulsively in each wheel, and 5 paddles immersed, with the centre one in a vertical position; the immersion of the lower edge being taken at the mean of $5\frac{1}{2}$ feet. The total amount of propelling surface in both wheels is then $201\frac{2}{3}$ square feet. The loss of labor by the oblique action of the paddles, calculated as the squares of the sines of their angles of incidence on the water, is 19 per cent. The total actual horse effect, developed by the engines, is by indicator:—

$\frac{4417.87 \times 14.078 \times 21.30 \times 7 \times 2}{33000} = 562,$

737 hours, with light breezes ahead, was 7.335 knots per hour. Double strokes of piston 10.65. Mean effective pressure on piston by indicator, 14.078 pounds per square inch. Consumption of bituminous coal per hour, 3078 pounds. The sea knot is usually taken at $6082\frac{2}{3}$ feet, which would make the speed of the vessel equal to 8.45 statute or land miles per hour.

From the above figures, the rolling circle (that is, a circle whose circumference multiplied by the number of revolutions of the paddle wheel in a given time equals the speed of the vessel in the same time) has a diameter of 21.7 feet. The mean diameter of the circles of the centres of re-action of the paddle surface in action, is 26.81 feet; the slip of the centre of re-action of the paddle surface is therefore as follows:—

being a little over the nominal horses' power, which is 500. I use the term "horse effect" instead of "horse power," as more logical.

If we now consider the power required to overcome friction and inertia of working parts of engine exclusive of engine at $5\frac{1}{2}$ per cent., and that required to work the air pump and load upon it at 1 pound per square inch on the steam piston, and the power to overcome the friction of the load upon the engine at 10 per cent., making a total of $22\frac{6}{10}$ per cent.; we have the following disposition of the power:—

Slip of the centre of reaction of the paddles	$17\frac{1}{10}$	percent.	or	96.10	actual horse effect.
Oblique action of the paddles	19	"	"	106.78	" " "
Overcoming friction of engine and load, and working air pump	$22\frac{6}{10}$	"	"	127.01	" " "
Leaving to be utilized in the propulsion of the vessel	$41\frac{3}{10}$	"	"	232.11	" " "
Totals	100.	"	"	562.00	" " "

In a paddle wheel steamer, where the engines furnish specially the motive power, sails should occupy but a very secondary consideration. Nevertheless it must be admitted that under certain circumstances, and within very narrow limits, they may occasionally be beneficially applied in connection with steam, so as to

economize the latter and preserve the same speed of vessel. Supposing the effect of the engines to be superior to that of the wind, it is evident the addition of sails would not only add nothing to the speed, but would retard it by being carried aback; on the other hand, if the power of the wind surpassed that of

the engines sufficiently to give the vessel a greater speed than the interior edge of the paddles, with the engines working at maximum velocity for safety, the paddles would carry a sea before them, and reduce the speed of the vessel by their drag. But if the power of engines and wind should be so proportioned, that with the paddles acting propulsively, the sails could be well filled without too much careening the vessel, then a decided benefit would result from the combination. The addition of some sail is also advantageous in a rough sea, by keeping up the speed of the vessel when the engine is nearly brought for a moment to a stand by a large wave rising on the wheel. When, however, the wind is abeam, and of sufficient force with sail set to considerably careen the vessel, the sail will be found injurious to the speed; an effect observed on the "Royal Yacht" paddle wheel steamer,

which, under these circumstances, went faster the more the sail was reduced.

The log of the "Mississippi" furnishes data for solving the question of the extent to which the use of sails as auxiliary to steam is useful in steamships. The mean of 420 hours under steam, and sail set to top and top-gallant sails with moderate breezes on the quarter, was 7.396 knots per hour, 19.95 strokes of piston per minute, 11.755 pounds per square inch mean effective steam pressure on piston by indicator, and consumption of 2310 pounds of bituminous coal per hour. Making the calculation from this data in the same manner as before, we obtain for the diameter of the rolling circle 23.93 ft. Mean diameter of the circles of the centres of reaction of the paddle surface in action, 27.35 feet; the slip of the centre of reaction of the paddle surface is therefore as follows:

$$\begin{aligned} \cdot 27.35 \times 3.1416 \times 9.975 \times 60 &= 51424.916 \text{ ft.} = \text{speed centre reaction per hour.} \\ 6082\frac{1}{3} \times 7.396 &= 44987.402 \text{ ft.} = \text{speed of vessel per hour.} \end{aligned}$$

$$6437.514 \text{ ft.} = \text{slip of centre of reaction per hour;}$$

or $12\frac{5}{10}$ per cent. The total amount of propelling surface in both wheels in action was now only 110 square feet. The total actual horse effect developed by the engines by indicator, is 1439.5. The mean immersion of the paddles being the

same as before, the loss by oblique action would be the same, and estimating the power to work the engine, and overcome friction of load, &c., in the same manner as before, we have the following disposition of the power:

Slip of the centre of reaction of the paddles $12\frac{5}{10}$ per cent. or 54.94 actual horses effect.

Oblique action " " " "	19	"	83.50
Overcoming friction of engines and load	}	24	" 104.48
and working air pump,			
Leaving to be utilized in the propulsion of the vessel,		44.5	" 195.58
		100	439.50

From the above "dispositions of the power," it will be observed that the addition of sail in the largest quantity, and under the most favorable circumstances for its efficient action, viz. set to top and top-gallant sails with moderate breezes on the quarter, decreased the slip of the paddle wheel $4\frac{5}{10}$ per cent., viz. from $17\frac{1}{10}$ to $12\frac{5}{10}$ per cent. Let us now ascertain the value of the power obtained from the sails in horse effect.

Referring to the "disposition of the power" in the first case without sails, we find that there was required 232.11

horse effect to propel the Mississippi at the speed of 7.335 knots per hour, and as the power is in the proportion of the cubes of the speeds, there would have been required to propel the vessel at the speed of 7.396 knots per hour, (without assistance from the sails,) $7.335^3 : 232.11 :: 7.396^3 : 237.91$. We thus perceive that without sails, there would have been required to propel the vessel at the speed of 7.396 knots per hour, 237.91 horses effect; but on referring to the "disposition of power" in the second case with sails, we find this speed to be produced

with the steam power of exerting only 195.58 horse effect, the balance therefore (237.91—195.58) 42.33 horse effect is due to the sails, and 42.33 is $9\frac{6}{10}$ per cent. of 439.5. This gain of $9\frac{6}{10}$ per cent., it will be observed, is wholly economical, the speed of the vessel not being sensibly increased. Had the engines been worked up to a higher power, and given the vessel a greater speed, it is obvious the gain from the sails would have been reduced, as the effective velocity of the wind would have been decreased as the speed of the vessel was increased. From the same reasoning we may infer, that, had the power of the engines been decreased with the resulting decrease of the vessel's speed, a higher per centage of gain could have been derived from the sails, but at the expense of speed in the vessel. Our calculations, however, establish the grand fact of which we were in search, viz. that retaining the same speed of vessel in a paddle wheel steamer, and that speed the *lowest* known in ocean navigation, the application of sails on a large scale and under the most favorable circumstances, operated a saving of only $9\frac{6}{10}$ per cent. Had the speed of the vessel been that of fast ocean steamers, viz. about 10 knots per hour, that saving would have probably been reduced to 2 or 3 per cent. When therefore we consider how rarely these "most favorable circumstances" occur, it is evident, that were not sails necessary for safety in case of accidents to the machinery, judicious economy would require their total suppression in paddle wheel steamers. They should, however, always be reduced to the minimum required for safety, for it is apparent that the air resistance of the rigging, masts, yards, &c., of a heavily sparred vessel, form a very considerable item in the consumption of power, not to mention the additional displacement caused by their weight.

The log of the "Mississippi" furnishes also illustrations of the effect of sail used on paddle-wheel steamers, under circumstances *not* the most favorable.

On May 31st, 1846, the "Mississippi," under steam alone for a mean of 10 hours, made 7.8 knots per hour. Mean effective pressure in cylinder, per square inch, by indicator, 17.4 pounds; double strokes of piston, 11.3 per minute, the breeze being moderate and two points off the bow.

The same day, the same moderate breeze having hauled so far around as to permit the yards to be braced sharp up, sail was set to topsails, and the mean result for 18 hours was a speed of $7\frac{1}{3}$ knots per hour. Mean effective pressure in cylinder per square inch, by indicator, $16\frac{1}{4}$ pounds. Double strokes of piston, $10\frac{2}{3}$ per minute.

In these two cases the steam power will compare as $17.4 \times 11.3 = 196.62$; and $16.25 \times 10\frac{2}{3} = 173.34$, or as 1.0000 to 0.8819. The speeds were as 7.8 to $7\frac{1}{3}$, or as 1.0000 to 0.9402, the cubes of which are 1.0000 and 0.8306. The slip of the wheel, in both cases, amounted to the same, viz. 17 per cent., and, as the effects were nearly in proportion to the steam powers alone, being only a little greater when steam was used with sails, viz. in the proportion of 1.061 to 1.0000; it shows that the addition of sails to topsails, with a moderate breeze and the yards sharp braced up, produces no effect, economically or potentially, when allowance is made for the same wind being more ahead when the sails were not used than when they were added.

I have appended Indicator diagrams, numbered from 1 to 8, to illustrate the working of the cylinder valves. From No. 1 to 5, inclusive, are given, though not taken for that purpose, to show the amount of steam opening that would be sufficient to maintain the initial pressure in the cylinder equal to the boiler pressure, less the allowance for the reduction caused by condensation and friction. From these diagrams it will be perceived that the steam opening was much larger than necessary for an engine working at the speed of the Mississippi's. At the time No. 5 was taken, the steam pressure in boiler per gauge was $8\frac{1}{2}$ pounds per square inch; strokes of piston 21, and the initial pressure in the cylinder 7 pounds per square inch with the throttle wide open, being a difference $1\frac{1}{2}$ pound. Back pressure in condenser, 1.1 pound, or 1.4 pound less than in the cylinder. When No. 4 was taken, the steam pressure in boiler, per gauge, was 6 pounds per square inch, strokes of piston 18, and the initial steam pressure in the cylinder, $4\frac{1}{2}$ pounds per square inch, with the throttle only $\frac{3}{8}$ ths open, being a difference as before of $1\frac{1}{2}$ pound. Back pressures in condenser 1 pound, or 2.2 pound less than in the cy-

linder. It thus appears that, with the ordinary speeds of piston, $\frac{3}{8}$ ths of the throttle supplied the cylinder, as well as the full throttle, proving that the proportion of steam valve opening to the cylinder capacity, viz: 1 square inch to 1162 cubic inches, is considerably greater than required. The exhaust opening appears, however, to be by no means too large, as with even the slow speed of the "Mississippi's" piston, the maximum condensation was not reached until the completion of the exhaust stroke.

When No. 1 was taken, the steam pressure in boiler was, per gauge, 6 pounds per square inch; strokes of piston 12 per minute; throttle close shut, cut off at two feet of the stroke from the beginning. Back pressure in condenser, per gauge, 1 pound per square inch, or 1.2 pound less than in the cylinder.

When No. 2 was taken, the steam pressure in boiler was, per gauge, $5\frac{1}{2}$ pounds per square inch; strokes of piston 14 per minute; throttle $\frac{1}{8}$ th open, cut off at two feet of the stroke from the beginning. Back pressure in condenser, per gauge, $1\frac{1}{2}$ pound per square inch, or 1.2 pound less than in the cylinder.

When No. 3 was taken, the steam pressure in boiler was, per gauge, 6 pounds per square inch; strokes of piston, 17 per minute; throttle $\frac{1}{4}$ th open. Cut off at two feet of the stroke from the beginning. Back pressure in condenser 0.825 pound, or 1.875 pound less than in the cylinder.

When No. 6 was taken, the steam pressure in boiler, per gauge, was 13 pounds per square inch, the strokes of the piston being 27 per minute, which was the maximum, the initial pressure in the cylinder was $11\frac{1}{4}$ pounds with wide throttle, or $1\frac{3}{4}$ pounds less than that in the boiler, and held up to the point of cutting off at three feet from the commencement of the stroke. Back pressure in condenser, 1.7 pound, or 2.3 pounds less than in the cylinder.

Nos. 7 and 8 are given to exhibit the limits between which the point of cutting off could be varied with the cut-off arrangement and proportions used, which was that known as Stevens'. No. 7 shows the point of shortest cutting off, which was 19 inches from commencement of stroke. When this diagram was taken the boiler pressure was $17\frac{1}{2}$ pounds per square inch, or $1\frac{1}{2}$ pound more than the initial cy-

linder pressure; strokes of piston 19 per minute; back pressure in condenser, per gauge, 1.2 pound per square inch, or $1\frac{1}{2}$ pound less than in the cylinder. No. 8 shows the point of longest cutting off, which was 14 inches from the end of the stroke. When this diagram was taken, the steam pressure in boiler was 10 pounds per square inch, or $1\frac{1}{4}$ pound more than the initial pressure in the cylinder, throttle wide open; the number of strokes of piston not noted, but evidently less than usual, as the "Mississippi" was engaged in towing the frigate "Cumberland," off the shoals of Anton Lizards, where she had grounded. Back pressure in condenser, per square inch, 1.7 pound, or 2.3 pounds less than in the cylinder. From this it appears that the air pump and condenser capacities were sufficiently large to condense and remove, at low velocities of piston, as great a bulk of steam as the boilers could supply.

The mean difference between the boiler and initial cylinder pressures was, from a large number of diagrams, $1\frac{3}{4}$ pound; and the mean difference between the condenser and cylinder back pressures, was also $1\frac{3}{4}$ pound.

Pambour, in his experiments on the steam engine, found, that during expansion, steam had always the temperature normal to its pressure; or, in other words, the relations between the density, temperature, and pressure of expanded steam, were the same as for steam in contact with water. A consequence of this fact should be, that the real pressure of expanded steam is less than its calculated pressure, by the law of Mariotte, which assumes the pressures to be inversely to the volume; which would be true if the temperature, during expansion, remained constant. But every Indicator diagram that I have seen taken from a steam cylinder, shows the actual pressure to be considerably more than would be given even by Mariotte's law; though it should have been considerably less according to Pambour's experiments. The discrepancy can, I think, be easily accounted for, and is due to two causes principally: 1st. The leakage of steam through the expansion valve after it has closed. 2d. The presence of water in the cylinder. The first is evidently the result of imperfect workmanship, or of the unequal expansion of parts; the second is caused either by priming, or by

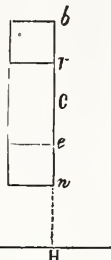
condensation of steam in the cylinder, and acts to increase the pressure in the following manner: After the steam is cut off, and its pressure reduced by expansion, any water in the cylinder having a higher temperature than that normal to the expanded pressure would be re-evaporated, and thereby increase the density and pressure of the expanded steam.

(To be continued.)

MECHANICS FOR THE MILLION.—NO. IV.

WORK IN RAISING MATERIAL HAVING A GIVEN FORM.

12. Let $n b$ be the mass raised from the horizontal line, $H R$, c the middle or centre of gravity of the mass, e and r , points equidistant from c . Now, if we suppose equal weights (say for example 3 lbs.) to be placed at e and r , the centre of gravity of these weights will be at c ; then



Work in raising 3 lbs. to $r = 3 \times H r$.

" " " to $e = 3 \times H e$.

$\therefore$ Total work in raising the material at r and $e = 3 \times H r + 3 \times H e = 3 (H r + H e) = 3 \times 2 \times H c$.

Now the same may be proved for any two points equi-distant from c , hence the work in raising the whole material, will be its weight, multiplied by the height to which the centre of gravity is raised.

The demonstration here given may be easily extended to more general cases.

Ex. 1. Required the work in raising the material in a wall 40 ft. long, 16 ft. high, and two ft. thick; supposing the weight of a cubic foot of the material to be 150 lbs.

Contents of the wall $= 40 \times 16 \times 2$.

Weight " $= 40 \times 16 \times 2 \times 150$.

Now the height of the centre of gravity of the wall will be 8 ft.

$\therefore$ Work $= 40 \times 16 \times 2 \times 150 \times 8 = 1536000$.

Ex. 2. The shaft of a pit is to be sunk 120 ft. in depth, and 6 ft. in diameter; required the work in raising the material, supposing a cubic foot to weigh 100 lbs.

Number cubic feet in the shaft $= 6^2 \times 120$.

Weight of material in shaft $= 6^2 \times 120 \times 100 = 3392928$ lbs.

$\therefore$ Work $= 3392928 \times \frac{1}{2} = 20,357,568$.

Ex. 3. Required the work in raising 3 cwts. of coals from a pit whose depth is 20 fathoms, the circumference of the rope being 2 inches, allowing that the weight of 1 foot of rope of 1 inch in circumference is .046 lbs.

Weight of one foot of the rope $= 2^2 \times .046 = .184$ lbs.

Weight of the whole rope $= .184 \times 120 = 22.08$ lbs.

$\therefore$ Work in raising the rope $= 22.08 \times \frac{1}{2} = 1324.8$.

Work in raising the coals $= 112 \times 3 \times 120 = 40320$.

$\therefore$ Total work $= 1324.8 + 40320 = 41644.8$.

Ex. 4. The material in the largest pyramids, Cheops, is 6 millions of tons, and the perpendicular height is 480 feet; required the bushels of coals which would be consumed in raising the material, supposing that a bushel of fuel employed in our best steam engines can perform 70 millions of work; required also the time which an engine of 300-horse powers would take to raise the material.

Weight of the material $= 6000000 \times 2240$ lbs.

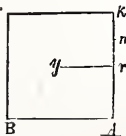
Now the centre of gravity of a pyramid is at one-fourth the perpendicular height, estimated from the base. See Art. 34.

$\therefore$ Work $= 6000000 \times 2240 \times \frac{480}{4}$.

$\therefore$ No. bushels $= \frac{6000000 \times 2240 \times 120}{70000000} = 23040$.

And time $= \frac{\text{Work}}{23000 \times 300 \times 60 \times 24} = 113$ days.

Ex. 6. This side, $A B$, of a cube of granite, is 4 ft., and the weight of a cubic foot is 170 lbs.; it is required to find the work necessary to overturn it on its edge, A .



Here the distance, $A y$, of the centre of gravity from the edge $= \frac{1}{2} \sqrt{2 \times 4^2} = 2.828$.

When the cube is about to fall, the centre of gravity, y , will be at n , in the vertical line, $A k$.

$\therefore$ The distance, $r n$, the centre of gravity will be elevated $= 2.828 - 2 = .828$ ft.

$\therefore$ Work $= 64 \times 170 \times .828 = 9008$.

Ex. 6. The perpendicular height, $d v$, of a right pyramid, is 12 feet, the side of the base, $A B$, which is square, is 8 feet,

and a cubic foot of the material weighs 100 lbs.; it is required to find the work necessary to overturn the pyramid upon its edge, A .

When the body is about to fall, the centre of gravity, y , will be at n , in the vertical line Ak , and the work in bringing the body to this position, will be due to the vertical distance, rn , through which the centre of gravity has been raised.

Then $Dy = Ar = \frac{1}{4}^2 = 3$; $AD = \frac{5}{2} = 4$;

Ay or $An = \sqrt{4^2 + 3^2} = 5$; and $rn = 5 - 3 = 2$.

Weight of the pyramid $= 8^2 \times \frac{1}{3} \times 100 = 25600$ lbs.

$\therefore$ Work $= \text{weight} \times rn = 25600 \times 2 = 51200$

Observation. The work necessary to overturn any body is the true measure of its stability.

Ex. 7. A cistern is 12 feet long, 6 feet broad, and 8 feet deep. The height of the bottom of the cistern from the water in the well is 36 feet. It is required to find the work in filling the cistern with water.

Weight water in the cistern $= 12 \times 6 \times 8 \times 62.5 = 36000$ lbs.

Now the height to which the centre of gravity of the water is raised $= \frac{8}{2} + 36 = 40$ ft.

$\therefore$ Work $= 36000 \times 40 = 1440000$.

Ex. 8. Required the same as in the last example, when the cistern is 6 feet long, 3 feet broad, and 4 feet deep, and the bottom of the cistern stands 18 feet from the water in the well. *Ans.* 90000.

SHORT METHOD OF MULTIPLICATION.

To the Editor of Appletons' Mechanics' Magazine.

SIR:—When one has many calculations to perform, any method that will lessen the figure-work is welcome. I am induced to send you, for insertion in your journal if you like it, the following exposition of a short method of multiplication, which I have often found extremely convenient and time-saving. I do not offer it as any thing original or new; but having recently seen that it was unknown to an otherwise expert arithmetician before whom I had occasion incidentally to employ it, it struck me that it might be equally unknown to many of your readers, who might perhaps be profited by its communication.

The method reposes upon certain properties of numbers, sufficiently curious in themselves but not treated of in the popular arithmetics. I do not mean to discuss those properties here, but only to give the rules and some examples.

If two factors are to be multiplied, consisting of any number of figures, but especially if the number be the same in both, take the difference between each factor and some standard number, such as 10, or some power of 10. These differences are the *complements* of the factors respectively. Subtract the complement of one factor from the other factor; the remainder will be the first figures on the left hand of the product desired. Then multiply the two complements whose product will be the last figures on the right hand of the product. The power of 10 taken as the standard number, show how many zeros, if any, are to be applied, and the decimal rank of the first and last figures. This will be easier understood by an example. Let it be required, for instance, to multiply 998 by 997. The reader may make that in the ordinary way for himself. My method executes it thus:

$$\begin{array}{r} 998 \times 997 = 995000 \\ \text{Compl. of } 1000 = 2 \times 3 = 6 \\ \hline 995006 \end{array}$$

Here 1000 is the power of 10, the nearest to the given factors, and the complements of the said factors are respectively 2 and 3. The difference between either of these complements, and the other factor, is 995 ($998 - 3 = 997 - 2 = 995$), which gives the first left-hand figures of the product. As 1000 is the 3rd power of 10, there must be six figures in the product, and three zeros are added to the right-hand. Then the two complements are multiplied, and their product set down on the extreme right. The sum is the product of the original factors. Again let it be required to multiply 82 by 95. We set down—

$$\begin{array}{r} 95 \times 82 = 7700 \\ \text{Compl. of } 100 = 5 \times 18 = 90 \\ \hline 7790 \end{array}$$

Here the second power of 10 is the standard number, and there must be, therefore, four places of figures in the product. The respective complements are 5 and 18; and their reciprocal differences ($95 - 18 = 82 - 5 = 77$), the two

left-hand figures of the product. The products of the complements give 90, which is put on the right hand, and the sum, 7790, is the product of the original factors.

It is evident that the greater the num-

$$\begin{array}{r} 9999999 \times 9999998 = 9999997 \\ \text{Compl. of } 10^7 = 1 \times 2 = \underline{0000002} \\ 99999970000002 \end{array}$$

As you use the 7th power of 10 for the thousand, there must be fourteen figures in the product. The complements are 1 and 2 respectively; and either subtracted from the other factor leaves 9999997 as the first seven numerals. The product of the complements is 2, which is only in the units' place, and requires six zeros before it to make up the other seven numerals required.

In these examples the standard number has been *greater* than the factors which has made the complements, always + or positive. The principle is just the same if the standard be *less* than the factors; only in this case the complements will be - or negative; and their subtraction (as in algebra) becomes actually an addition. If we only observe the signs, we can never make a mistake. Thus let it be required to find the product of 105 by 119. We write it thus—

$$\begin{array}{r} 105 \times 119 = 124 \\ \text{Compl. of } 10^2 = -5 \times -19 = 95 \\ \hline 12495 \end{array}$$

Here, as in taking complements, the standard is universally + or positive, the complements -5 and -19 become negative, and as the subtraction of a negative quantity is the same as the addition of a positive one, one or the other (it is plain, no matter which) is added to its reciprocal factor; giving 124 for the three left-hand figures. And as this standard is the 2d power of ten, there must be four places following the unit. The product of the two complements just fills up the remaining two places and 12495 in the product required.

Another variety of illustration is afforded when one factor is greater and the other less than the standard number. Thus to multiply 95 by 106, write—

$$\begin{array}{r} 95 \times 106 = 10100 \\ 5 \times -6 = -30 \\ \hline 10070 \end{array}$$

Here the complement of 106 is — or

ber of figures in the factors, the greater the convenience of this method. Thus to multiply 9999999 by 9999998 is fatiguing by the usual process. By this method you write—

negative, while that of 95 is + or positive. But it is obvious that the result is the same, whether we subtract 5 from 106 or add 6 to 95. In either case it is 101, which must be followed by two zeros, because the standard is the 2nd power of 10. The product of the complements is necessarily negative, and the addition of a negative is the subtraction of a positive, as is done in the example.

In all these examples, the factors have been near the power of 10 assumed for the standard. The method is hardly less convenient when the complements are larger, provided they are aliquot to 10 or its powers, and can be worked with fewer figures than the ordinary short way of aliquotage. Thus to multiply 875 by 916 in each method—

Present Rule.

$$\begin{array}{r} 875 \times 916 = 791 \dots \\ \text{Com. } 10^3 125 \times 84 = \frac{10500}{801500} = 84^{\frac{00}{8}} \end{array}$$

Ordinary Aliquotage.

$$\begin{array}{r} 916 \times 1000 = 916000 \\ \frac{1}{2} \times = 458000 \\ \frac{1}{4} \times = 229000 \\ \frac{1}{8} \times = 114500 \\ \hline 801500 \end{array}$$

Shortest Aliquotage.

$$\begin{array}{r} 916 \times 1000 = 916000 \\ \text{Subtr. } \frac{1}{8} \quad 114500 \\ \hline 801500 \end{array}$$

In this example, the ordinary method requires the writing of 43 figures; the shortest aliquotage 27 figures; the present method 25 figures.

Hitherto the powers of 10 have been assumed as the standard, which is the most convenient when they yield complements sufficiently small. But any round number nearest to the value of the factors may be taken as well, only the difference of the factor and complement must be multiplied by the standard number.

When powers of ten are used, such multiplication effects itself. For instance, to multiply 56×61 , take here 50 as the standard, and with—

$$\begin{array}{r} 56 \times 61 = 67 \times 50 = 3350 \\ \text{Complt. } 50 \quad -6 \times -11 = \quad +66 \\ \hline 3416 \end{array}$$

Again, to obtain the product of 76×73 , write as follows—

$$\begin{array}{r} 76 \times 73 = 69 \times 80 = 5520 \\ \text{Complt. } 80 \quad 4 \times 7 \quad = \quad 28 \\ \hline 5548 \end{array}$$

The examples suffice to show the application and fecundity of the method. The following remarks should be made in connection with it: 1st. When the factors do not transcend the units' place, the method, though equally true, is without interest. 2nd. When the factors do not contain more than two places, there is no gain by the method. 3rd. In proportion as the number of places in the factor increase, the method is convenient; and especially the smaller the complements of said factors with powers or multiples of 10, or aliquot parts of such powers or multiples. 4th. In obtaining the squares of numbers and involutions to a higher degree, the rule may very often be advantageously applied.

The theory of all that precedes is very simple; and every one with a taste for figures can easily devise the artifices that give to this method a feasibility far greater than is shown by any thing said here.

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BRADFORD'S PATENT LOCKS.

From the London Mechanics' Magazine.

Specification.

My improvements in locks consist in the addition thereto of spring bolts or catches, which take into the tumbler, or into the bolt of the lock, and are disposed in such positions, that the tumbler or bolt cannot be moved with a picker or other such instrument until the spring bolt or catch has been removed.

Fig. 1 is a back view of a drawer lock constructed with these improvements; fig. 2 is a front view of it, and fig. 3 a view of the interior of the lock, with the cap plate removed. A is the lock plate; B, a cap, which covers the springs c and d shown in fig. 4, which is a view of the back of the lock with the cap B removed.

The spring c is immediately opposite to the lock-pin e, which is made hollow, and has fitted into it a small rod or pin a, the head of which rests upon the spring c. Within the pipe of the key there is fitted a pin a¹ of the same size as the pin a inserted into the hollow pin of the lock. The lengths of these pins are so arranged, that when the key is put into the lock it causes the pin a to press against the spring c, and thereby raise up the free end of that spring, which withdraws a pin b, which takes into a hole drilled in the bolt f. The withdrawing of the pin b allows the key to push over the bolt. Unless the key used for the lock were provided with arrangements for acting upon the pin b the bolt could not be shifted by it. In the bolt there is another hole which receives the pin b when the bolt is in its locked position.

The spring d has a pin e attached to it, which, like the pin b, takes into one or other of two holes ff, which are drilled in the bolt f, that is, when the bolt is in its locked and open positions, and prevents the bolt from being shifted out of either of those positions, unless when the pin e is withdrawn from the bolt, which is effected by means of the projecting piece g, formed upon the lower edge of the key, shown separately in fig. 5, which, during the turning round of the key within the lock presses upon a projecting-ledge h, formed upon the side of the plate g. Edge and end views of the plate G are given in figs. 6 and 7. Fig. 8 is an edge view of the entire lock. When the key presses upon the edge of the plate G, it raises up the spring d, and the pin e, attached to it from its hold of the bolt of the lock, and allows it during that interval to be shifted, either to be locked or unlocked. Upon the face of the lock there is an arrangement somewhat similar to that last described, by which a pin, e¹ is made to take into a hole h, drilled into the tumbler H, and by which the tumbler is prevented from being raised so as to liberate the bolt f until that pin has been removed. The projecting pin g¹, upon the key, actuates the plate G¹, and the spring d¹, in the same way as has been described in regard to the movement of the similar parts upon the opposite side of the lock. The bolt f is furnished with a guard f², upon that edge of it nearest to the key, which forms a complete obstruction to the

Fig. 1.

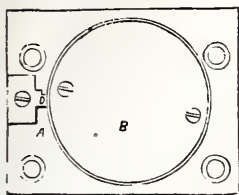


Fig. 4.

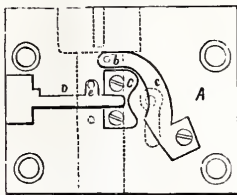


Fig. 6.



Fig. 5.



Fig. 2.

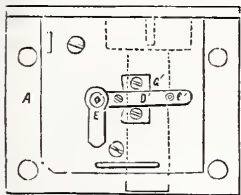


Fig. 3.

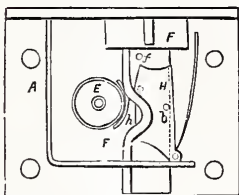


Fig. 8.

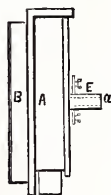


Fig. 10.

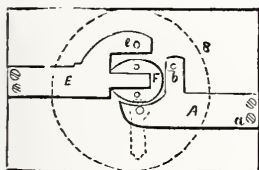


Fig. 11.

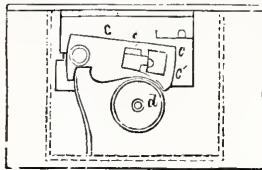


Fig. 9.



passing of any picker ever to lift the tumbler.

Fig. 9 is an edge view of a chest lock constructed upon the same principle as the lock just described, and fig. 10 a back view of fig. 9 with the cap removed. Fig. 11 is a front view of the lock with the cap removed, in order to show the interior. A is a spring which is attached to the plate of the lock by the screws *a a*, and has a pin *b* connected to it (at the other end), which pin passes through the lock-plate B, and takes into one or other of the holes *c c*, in the bolt C. The bolt C is liberated from the hold of the pin *b* when the key is put into the lock, by means of the pin or rod *d*, which is inserted into the hollow pin of the lock D, being pressed downwards by the pin *a*¹, placed in the upper end of the pipe of the key, as before explained. E is another spring which is actuated by the plate F, and carries a pin *e*, which also takes into holes *f f* in the bolt C. The plate F is similar to the plate G, shown separately

in figs. 6 and 7, and is raised up by means of the projecting piece upon the edge of the key, all as before explained. From the preceding description given of the additional parts, which I have put to the locks, represented in the engravings, it will be obvious, that the same principles of construction, with very slight modifications, may be applied to locks of other descriptions.

EDWARD N. SMITH, OF WEST BROOKFIELD, MASSACHUSETTS, FOR A MACHINE TO FOLD PAPER. *Patent dated July 17th, 1850.*

These improvements are in the construction of a self-acting folding machine, by which the paper may be folded any number of times, and to any required size, and it may be so attached to a printing machine, that the papers printed, may also be folded ready for use, without the labor of any individual. The machine consists of cast-iron frames, giving support to the bearings, which are to receive the pivots

of rollers of a proper diameter, and perfectly parallel. Round these rollers, at certain intervals, are a series of endless straps, these being supported at certain lengths by bearing rollers, the whole width of the straps forming together an endless moveable table or frame, of the size of the paper to be folded. The under part of the frame of the machine is so constructed, as to form bearings to receive the first motion or main shaft, which by a suitable arrangement of spur wheels, gives motion to a second shaft, on which is fixed one or more grooved drums, the grooves being so made, as for the greater part of the circumference of the drum to be concentric with it, except at one point, where there is a projecting piece, the curve of which the groove is made to follow; a roller which is fixed to the end of a lever is made to work in this groove; consequently, during almost the entire revolution of the drum (the groove being concentric), the lever is perfectly stationary, until such time as the roller arrives at the raised part of the groove, when its projection causes the lever to vibrate on its centre. To the end of this lever is fixed a rod, leading to a cast-iron frame, to which a thin blade or knife is fixed; this, by the action of the drum and lever before described, is made to rise between the endless straps in the middle of the table, and striking the sheet of paper in the middle, raises it off the moveable table, and carries it between two rollers set in motion from the main shaft, by means of a vertical shaft worked by a pair of bevel wheels; this vertical shaft has at its upper end another pair of bevel wheels, which give motion to a horizontal shaft, and finally these by a third pair of bevel wheels to the rollers before named, these gearing with each other by proper spur wheels; after passing between these rollers, the now folded paper is carried on a second moveable table or surface, similar in construction to the first, having, however, only half its area, and moving at right angles to the first. A blade or knife is made to rise by mechanism worked by a second drum, placed on the revolving shaft; and this blade being at right angles to the first, raises the paper off the second table, and passing between two other rollers, is now a second time folded; from thence it is laid on a third moveable table, half the size of the second, also moving

at right angles to it, and in the same direction as the first. The third moving is worked by a third drum and lever, in the same manner as described for the first and second, and the paper after being raised by the third blade is passed between rollers on to the fourth moveable table, one-half the size of the third, and working at right angles to it. After being folded on this, the paper is tumbled down a "chute" into a box or other proper receptacle placed to receive the folded papers. By a modification of the machine, they may be folded in parallel folds instead of cross ones, when required.

The patentee states that he makes no claim to the well-known principle of a person folding a sheet of paper by crowding or pushing it with a thin blade or plate, between two surfaces; but that his invention embodies such surfaces and contrivances with mechanism, so as a whole, to become an automatic machine, capable of folding a sheet of paper to great practical advantage.

The patentee claims—

An automatic mechanical combination, composed of elements, which, by their operating together, strike the sheet to be folded on the line in which the fold is to be made, double the paper together, and complete the folding.

The elements are—

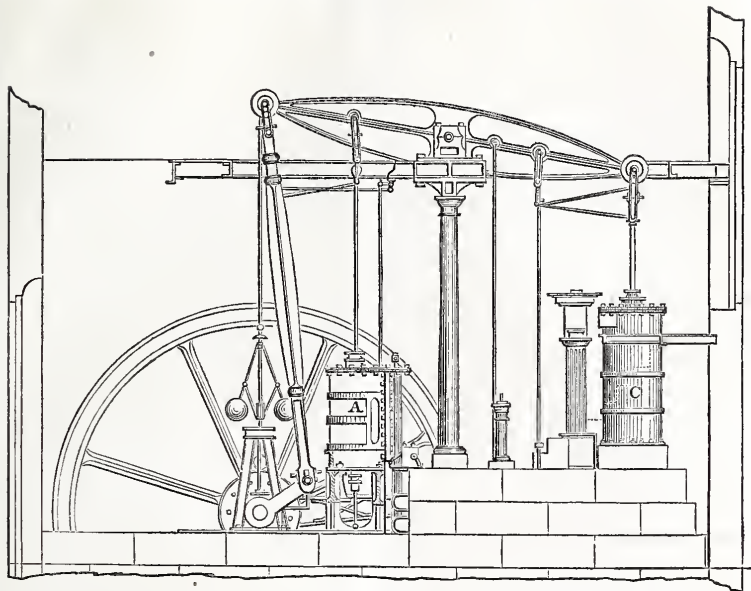
First—That of striking the sheet in the middle, or any other part where the fold is to be made, and advancing it towards or between the folding surfaces.

Secondly—Machinery to further move the paper between the surfaces by which it is folded.

Thirdly—The folding surfaces or mechanism which complete the folding, the whole being constructed and made to operate in the manner described, or in any other manner which preserves the principle. Also an automatic mechanical combination of two or more such collections, for the purpose of folding a sheet in two or more folds, substantially as specified.

M'NAUGHT'S PATENT DOUBLE CYLINDER ENGINE.

This is of so simple a character, that the drawing leaves but little to do in the way of description. To the ordinary low pressure condensing engine is applied a high pressure cylinder, A, on the *crank side*



of the beam, the steam passing from it into the low pressure cylinder, c, where it expands, and whence it finally escapes into the condenser. By this means, therefore, an ordinary low pressure engine may be converted into a high pressure expansive engine, with an important saving of fuel as well as an increase of power. The reason for placing the high pressure cylinder on the opposite end of the beam to the low pressure cylinder is readily seen. The strain on the main centre and pillars and wall being double that on the end of the beam, any additional load placed on the same end as the low pressure cylinder would aggravate the evil which always exists in over-loaded engines, but which is entirely removed by the additional strain being placed at the opposite end, whereby the engine is brought into equilibrium, and the strain removed from the main centre, which has the effect of causing the engine to work much more smoothly, and with a corresponding diminution of wear and tear.

It is such a common practice for manufactures to increase their works and add machinery, without considering that their engines are probably already fully loaded,

that we are not surprised that they have availed themselves so readily of the relief offered by this simple and inexpensive arrangement. From the numerous testimonials which Mr. M'Naught has received, we gather that the saving of fuel accomplished is from 30 to 40 per cent., and the increase of power in about the same proportion, but of course varying with the previous state of the engine.

THE NEW SOUNDING-MACHINE OF M. FAYE.

The immensity of ocean, whose mighty extent spreads over more than two-thirds of the globe's surface, hides in its vast bosom many phenomena, a knowledge of which would lead to results of high importance and value to physical science; while the enormous depths to which it extends, seeming to defy penetration, render the difficulty of observing these phenomena, so great as to seem almost impossible.

To overcome this difficulty, the attention, not only of the first men of science of our days, but of many distinguished philosophers of past time, has been turned. The invention, lately presented to the institute of France, by M. Faye,

would seem, however, to be the only thoroughly applicable solution, which that difficulty has yet received; and it is highly interesting, both on account of the ingenuity and talent displayed in its construction, and its importance to the progress of science.

The objections to the common sounding-lead are numerous; while the difficulties attending its employment at a depth of 4,500 yards, (two miles and a half,) are so great as to render it inapplicable to a greater depth. Experience shows these difficulties to be much greater than is generally imagined. Thus, at a depth of 2,500 yards, the resistance is upwards of 5 cwt., and would require thirty men to overcome it, allowing 20 lbs. for each man; while, at double the distance, the resistance amounts to nearly half a ton. In the former case, the time required is two hours,—half an hour for the lead descending, and an hour and a half for hauling it in.

Among these difficulties is the risk of losing the line by breakage, a not unfrequent occurrence, which often causes a great loss. One case is noted in which one mile and three quarters of line were lost; an expense of upwards of £150. It follows, therefore, that the sounding-lead is inapplicable as an instrument of scientific research; for it cannot be used further than two miles and a half deep; and the average depth of the ocean, deduced from the tidal phenomena, is about ten miles. Some other means are required, then, to penetrate these depths.

The first instrument for effecting this, which we find noted, is an invention of one Besson, a mathematician, who, in 1567, published an account of his sounding-machine. It consists of a vessel full of air, loaded so as to make it sink, and so disposed, that when it touches the bottom, is set free its load, and rose to the surface, by its smaller specific gravity. The depth was then to be calculated by the time employed between the sinking of the machine and the rising to the surface of the air-tight vessel. Among others who applied their talents to the improvement of this apparatus, were Dr. Hooke, and Désaguliers, but they seem to have produced nothing which was practically useful. And amongst the various propositions on the subject, is a highly ingenious one of M. de Tesson, who proposed to use a

bomb, with a detonating apparatus, so arranged, that the bomb might be exploded the moment it touched the bottom; the depth being calculated by the time employed between the immersion of the bomb and its detonation.

The experiments made some years since on the Lake of Genoa, in which a bell struck under water was distinctly heard at a distance of upwards of ten miles, removed all doubt as to the detonation of the bomb being heard. It is the instrument of M. Faye, however, which alone combines every requisite. The ingenious arrangements of its parts permit it to withstand, with the greatest ease, the most enormous pressures it may be subjected to, (for example, a depth of ten miles, the mean depth of the ocean, would exert a pressure of considerably more than three tons, or forty-five atmospheres on every square inch of longitudinal and vertical surface,) and enables us to determine the depth of the bottom of the sea, the direction and force of the submarine currents, the temperature at the bottom as well as at any required depth, and the composition of the water.

The apparatus consists of a cylinder of sheet iron, or copper, with a conical top and bottom. This cylinder is filled with a liquid, specifically lighter than water,—a small orifice near the bottom allowing the pressure of the water to be exerted on the inside, as well as on the outside of the machine. To sink the machine, two cannon-balls are attached; and when it arrives at the bottom, a stop, projecting below the cannon-balls, is forced upwards and disconnects them. The machine then rises to the surface, by virtue of the lightness of the liquid contained. This liquid would, of course, be contracted by the cold at the bottom, and the space left would be filled by the sea-water. And the orifice is so arranged, that, when the liquid expands upon reaching the surface of the water, to its original bulk, the sea-water so entering, shall remain, and a corresponding portion of the liquid be forced out through the orifice: the volume of the sea-water contained denoting the temperature at the bottom. When this is not deemed sufficiently accurate, a tube of mercury, similarly arranged, within an orifice near the bottom, may be used. A meter, fixed to the machine, denotes the distance

through which it has passed; and by connecting the apparatus for setting free the sinking-weight, with this meter, the machine may be made to descend to any given depth; its relative position, when it rises to the surface, determining the force and direction of the current at that depth. To collect a portion of water at the bottom, or any required depth, a small vessel is attached, upside down, and shuts when in that position by a valve, which, when the disconnecting apparatus sets free the weight, and brings the vessel to its proper position, opens, and allows the water to flow in.

The thickness of the metal used is 1-50th of an inch,—the diameter of the cylinder is 16 inch., and the height 3 feet 6 inch. With the disconnecting apparatus, it weighs 24 lbs., and costs about £12. It contains 250 lbs. of oil of potatoes, and when filled with that liquid, weighs upwards of 30 lbs. lighter than the quantity of water it displaces. To sink it, a couple of cannon-balls, each weighing a quarter of a hundred, would be sufficient. It is obvious, that the only loss, each time, is that of the sinking weight, which would give an expense, taking cast iron at £10, of 5s. The time employed in the operation, would be less than in the case of the sounding-lead, namely, 1,000 fathoms an hour.

While we admire the talent and ingenuity which thus displays to us these treasures, which the hitherto inaccessible depths of the ocean have concealed from science, and render every justice to the importance of this invention, so immeasurably superior to all that has been done before in the matter, we should wish to see it even more perfect still; for example, in the case of currents, this machine gives only the mean direction and force at any given depth, and gives us no record of the various currents it may have passed through on its way to that depth. Let us hope that, ere long, British inventive genius may, by rendering it perfect, confer another boon on physical science.

INSTITUTION OF CIVIL ENGINEERS, JANUARY 21, 1851. WILLIAM CUBITT, ESQ., PRESIDENT, IN THE CHAIR.

The discussion on Mr. Digby Wyatt's paper, "On the Construction of the Building for the Exhibition of the Works of

Industry of All Nations, in 1851," was continued throughout both these meetings.

On the one side it was contended, that the present building was not in accordance with the conditions published by the Royal Commissioners; that, from its form, the wind would have a most injurious effect on it; and therefore, that instead of testing each girder singly, as had been done, the whole roof should have been subjected to the same ordeal as Turner's roof over the Railway Station at Liverpool, which had been proved by suspending weights at intervals, on the presumed necessity for its bearing a strain of wind equal to fifty pounds per square foot. This test of proof had been suggested by Mr. Loek and Mr. Fox, and therefore it could not be objected to now. The snugs, for receiving the ends of the girders, were considered as being too weak, and liable to fracture. The foundation of concrete under each column was considered insufficient, and not in accordance with the original design, as set forth in the *Illustrated London News* of July 6th, 1850, where a proper kind of foundation was stated to be provided. The columns of such slender dimensions as eight inches diameter, and varying from one inch and an eighth down to half an inch in thickness, and each composed of seven parts, must be unstable when carried to such heights as sixty-four feet.

The girders of the galleries, when under the action of the multitudes of persons all in one direction, would acquire an undulating motion which would fracture them.

The glass of the roof being only of the weight of sixteen ounces per square foot, or about one-eighth of an inch in thickness, was quite inadequate to resist hail-storms, or even the weight of a fall of snow, and that great leakage must be expected from this and several other causes. The condensed vapor from the under side of the iron beams would also drop on the goods exhibited, to their serious injury.

The quantity of timber employed, and the system of open flooring, rendered the building peculiarly liable to catch fire: and on these grounds it was asserted to be wanting in the stability and security requisite for a receptacle for the valuables which would be transmitted for exhibition. It had been stated by the Royal

Commissioners, that a building would be provided, free of rent, and fire-proof: the latter condition was certainly not fulfilled, and if the building remained uninsured, each exhibitor would be under the necessity of providing for the safety of his own goods, and thus be subjected to a greater expense than the ordinary rent of a really fire-proof building.

On the other side, it was admitted that, up to the present time, the building was not insured against fire. It was, however, contended, that an examination in detail of all the parts of the structure demonstrated the fallacy of the objections which had been made. Every part had been attentively considered, and had been subjected to careful and minute experiment. The concrete foundation had been tested to the extent of seven tons per square foot without crushing, whilst the greatest weight that could be brought upon each square foot of foundation was only two and a half tons; this was supposing the building to be crowded with visitors, and the roof covered with a depth of two feet of snow.

The columns had also been submitted to similar experiments; their thickness varied from half an inch to one inch and an eighth, according to the duty they had to perform, and the position they occupied in the building. It had been calculated that the greatest weight which could possibly be brought upon the strongest column was sixty tons, whilst its breaking weight exceeded three hundred tons.

The glass was considered to be sufficiently strong, as its thickness and quality were similar to that used in the large conservatory at Chatsworth, of which not a pane had been broken by any hail-storm that had occurred since its erection twelve years ago. The canvas employed outside would not only temper the rays of the sun, and aid in ventilation, but would also assist in preventing fracture of the glass; and in consequence of the canvas itself being fixed to each ridge in narrow strips, if any portion did catch fire, only that piece would be burned. It was further stated, that on the present design being accepted, an offer had been received for its construction from the person who now most violently attacked the original design and its actual construction.

JANUARY 28, 1851.

Arguments, based on calculations, were adduced to show, that though the building was amply sufficient for resisting any vertical pressure to which it might be subjected, it was not so well calculated to resist the horizontal force exerted by the wind, which might be taken as sometimes equalling 25lbs. per square foot.

The building in Hyde Park was the most extensive example in existence of the "pure rectangular construction," but as it did not possess the strong gable and walls of the Lancashire cotton mills, which were also rectangular structures, composed of columns and girders—the stability of the glass structure must depend entirely on the simple rectangular form, which could only be maintained by the perfect attachment of the girders to the columns. It was contended that the snugs by which this was effected were wanting in strength, and that the columns not being attached to, or rooted into the ground, might be supposed to admit of lateral motion. The addition of strong diagonal bracing was therefore recommended, as being necessary to insure that amount of stability requisite in a building intended for the circulation of such multitudes of persons as would attend the Exhibition.

The great amount of light admitted through a roof entirely composed of glass, was considered objectionable for the display of works of art; and it was contended that a roof partially covered with slates would have been better for general purposes.

Explanations were entered into to show, that the snugs for supporting the girders were amply strong, not only for the general duties they had to perform, but also for resisting any tension, or accidental strains which might be brought on them by the failure of any adjacent parts; and instances were adduced of the occurrence of accidents, during the course of construction, which had proved this position to be correct.

It was contended that the glass was sufficiently thick, and that, in an extent of roofing of almost forty acres, constructed by one firm during the last twelve years, wherein no glass exceeding 16 oz. per square foot had been employed, scarcely any breakage had occurred.

It was proposed to use Sir W. Burnett's system of saturation, by a metallic salt, to prevent the accidental burning of the canvas on the roof.

The construction provided for the effects of contraction and expansion, consequent on the changes of temperature.

GEM AND GLASS ENGRAVING.

(From Holtzapffel on Turning.)

To give steadiness to the arms of the artist, they are supported upon the bench, but the position depends partly upon the form of engine employed, and partly upon the habit of the individual. When the common form of engine is used, the palm of the left-hand is generally rested upon the hemispherical cap of the engine, while the forefinger and thumb embrace the revolving tool, and grasp the upper end of the stick on which the stone is mounted. The thumb and forefinger of the right-hand grasp the stick just below those of the left, and the right elbow is supported upon a cushion about 6 inches diameter; this position gives considerable steadiness to the hands, and allows of a free motion to the fingers, between which the stick is, as it were, suspended; it is, however, rather adapted to small than large stones.

When the engine is made more in the form of a lathe head, and overhangs the pillar, a different position of the left-hand is generally adopted. In this case, the left elbow is supported upon a cushion, in the same manner as the right, the two elbows being widely separated, to lower the hands beneath the tool, and give a wide base to the arms. The left-hand is rested against the under side of the overhanging frame, and in some cases the right wrist is supported upon a wooden rest, about 6 in. high, and 2 in. diameter, having a hemispherical top to allow of the free motion of the wrist in all directions; and the base of the rest is enlarged to about 4 inches diameter, for greater steadiness. The choice of position is not very material, and depends principally upon habit; but those artists who are accustomed to one position cannot conveniently adopt another. The point of greatest importance is, that both hands should be perfectly steady, and capable of being moved in all directions with great freedom. The wooden rest

gives great steadiness to the right wrist, but is liable to interfere with the free motion of the hand; it is, therefore, often dispensed with, except for very delicate works.

The general position of the stick is nearly vertical, so as to keep the surface of the stone inclined sufficiently to prevent the stem of the tool coming in contact with the face of the stone. In dotting the outline, or cutting shallow works with large tools, the stone may be held quite horizontal; but in cutting deep and delicate works, or sharp angles, very small tools must necessarily be employed, and the stone then requires to be considerably inclined, in order to allow the edge of the tool to penetrate to the bottom of the cavity, without risk of the stem being brought in contact with the surface of the work.

In all cases in which the stone can be kept horizontal, the process of gem engraving is comparatively easy, and the principal difficulties that are met with occur in cutting the curved outlines, and in making a sunk surface quite flat. As previously mentioned, the edges of sunk surfaces should be made nearly perpendicular, to give definition to the impression, and the outlines are cut with a thin tool, in which the face of the tool is flat, but to give strength, the back is necessarily made conical.

In those cases in which the flat face of the tool can be applied to the convex side of a curved recess, no material difficulty is experienced in cutting the outline nearly perpendicular, as the stone can be slowly, but continuously, twisted round, to bring every successive part of the curve in a direct line with the flat face of the tool; and should the edge of the outline be irregularly cut at the first attempt, a second cut may be taken with a smaller tool in the same manner, to correct the irregularities of the edge; and during the entire process the tool and work remain constantly under observation.

But it will be readily conceived that the flat face of the tool cannot be so conveniently applied to the concave side of the recess, as the edges would have a continual tendency to encroach upon the curved line, and, therefore, in cutting around the concave side of a curve, the conical back of the tool must be made to

traverse around the inside of the curve; but the back of the tool being less under observation than the face, it is much more difficult to cut the edge smoothly, and in any attempts to correct the irregularities with a smaller tool, it is necessary to adopt the same course of applying the back of the tool to the concave edge of the work, as it is found that when the edge has been cut with the back of the tool, the face cannot be successfully applied to rectify any minute errors.

The difficulty of making a sunken surface quite flat, arises from the circumstance that the entire face has to be produced with only a very small portion of the edge of the tool, and without any mechanical guidance being derived from the tool itself. For although the edge of a tool, such as they use, may be turned very nearly flat, still, on examination, after being used, it will always be found rather convex, owing to the circumstance that the edge has a constant tendency to wear the fastest at the margins, and the rounded edge of the tool has, of course, a continual tendency to cut the surfaces to which it is applied into a series of small hollows, instead of one continuous plane.

In flattening a sunken surface, or, as it is sometimes called, *stippling*, the difficulty is overcome by keeping the stone in continual but steady motion. The stone being quickly traversed with very short strokes beneath the tool, the entire surface is successively passed under the lowest point of the tool, which is only allowed to cut at the highest points of the surface, and these are determined apparently by intuition, so delicate is the sense of feeling acquired by the best gem-engravers; but, as may be imagined, this great dexterity of hand is only to be acquired by long and patient practice.

When the stone requires to be much inclined from the perpendicular, to allow small tools to penetrate into the minute details of deep works, the difficulties of gem-engraving are materially increased. As previously mentioned, some of the little disks are less than one-hundredth of an inch in diameter, while, to afford sufficient stiffness to the tool, the diameter of the stem requires to be about one-eighth of an inch at the back, and the

front end is made conical for about one inch of its length from the disk. To enable these small tools to penetrate even into a flat surface, it is obvious that the stone must be inclined to a greater angle than the cone of the stem, or the latter would rub on the flat surface; but in finishing a deep corner, so as to make it quite square and sharp at the bottom, the stone must be inclined to a much greater angle, and in consequence, instead of the tool cutting perpendicularly downwards, it cuts obliquely, at the same angle as that at which the stick is held, and this tendency of the tool requires to be overcome by the tact of the artist.

In the case of squaring a corner, there is generally sufficient room in the sunken portion to allow the entire disk to be inserted within the cavity, upon the side of which it is principally required to operate, and the surface of the stone may be held nearly vertical. But in cutting fine lines on a deep surface, such as some of the finishing lines in the hair of a deeply sunk head, the lines do not admit of being made much wider than the edge of the tool. Very delicate management is required to sink these lines perpendicular to the general surface, and the stone must be applied to the tool so as to commence the line a little above the exact position for the centre of the line, in order that the oblique cut, when made to the appropriate depth, may terminate in the desired position.

In ordinary seal-engraving, great accuracy of finish in the details is never attempted, and these difficulties of manipulation are not severely felt, but they are a great obstacle to the practice of the higher department of gem-sculpture,—which not only requires the artist to possess great talent for the conception of beautiful designs in sculpture, but he must also devote many years to the attainment of sufficient mechanical dexterity, to enable him to realize in detail the conceptions of his mind. The gem-engraver also labors under the further disadvantage, that from the minute and delicate character of his works, they can only be properly appreciated by those few persons who have carefully studied the subject.

It is very generally supposed that the ancients greatly excelled the moderns in

gem-engraving, and that the art has never been carried to the highest perfection in this country. Mr. Henry Weigall, however, states that—"this supposition is erroneous, and has probably arisen from the fact of travellers supposing that the collections of gems and impressions that they have made in Italy, are exclusively the works of Italian artists; such, however, is not the case, and I have myself had the satisfaction of pointing out to many such collectors, that the most admired specimens in their collections were the works of English artists. Selections may be made from the works of Wray, Burch, Marchant, and Charles Weigall, which will bear a comparison with the finest works that have been produced in any age or country."

Mr. Henry Weigall could not, of course, speak of his own performances, but the reputation his works have acquired in this and other countries, would fully justify the insertion of his name in the above list.

The engraved surfaces of ordinary works, such as armorial bearings, are commonly left from the cutting tools, and are not afterwards polished; but in superior specimens of gem-engraving, when it is desired to give the work the highest possible finish, the engraved surfaces are all polished in the most careful manner. For this purpose the surfaces are first smoothed with copper tools, made of the same shapes as the finishing tools used in engraving, and charged in the same manner with diamond powder and oil; but the diamond powder is ground finer than that used in engraving, and the copper tools being softer than those of iron, the particles of diamond become more deeply imbedded in the surface of the tools, and therefore leave a much smoother surface. After all the engraved surfaces have been smoothed with copper tools, similar tools made of boxwood, charged with still finer diamond powder, are employed to complete the smoothing. The boxwood tools cut very smoothly, and leave almost a semi-polish, which is completed with copper tools charged with rottenstone and water.

The process of polishing minute works with much detail, is, however, very tedious, as every one of the markings requires to be operated upon separately, and the process demands much skill and

attention to prevent the sharpness and delicacy of the engraving from being deteriorated. To economize time in polishing common works, where precision of form in the details is not considered of primary importance, scratch brushes are sometimes employed; these are made of fine copper wire fixed in the end of a tool, and sometimes bent up at right angles to the axis, to make a small wheel-brush, which is charged in like manner with rottenstone and water; but the practice is not to be recommended, as it obliterates the delicate forms.

The process of seal-engraving is applied to all gems inferior in hardness to the diamond, and even this is said to have been engraved in some rare instances. The sapphire cuts very slowly but smoothly; the ruby cuts slowly, but small pieces are liable to break off in flakes; carnelian and blood-stone are close in their structure, and admit of being cut with very smooth surfaces. Softer stones admit of being cut more rapidly, but do not when finished present such smooth surfaces as the harder and more compact materials. The amethyst is, perhaps, as soft a stone as can be cut very smoothly; nevertheless, glass, and even marble are sometimes successfully treated by the seal-engraver, but the tools soon become deteriorated, owing to the diamond powder becoming imbedded in these soft materials. When the stones consist of layers of different degrees of hardness, increased caution is required to prevent the tool penetrating more deeply at the softer parts. An onyx engraved in intaglio, so that the device is seen from the surface in the colors of the lower stratum, is called a *nicolei*.

The very excellent proof-impressions of seals, taken in wax by the seal-engravers, are produced in the following manner:—The stone is first thoroughly cleaned with a moderately soft brush, it is then warmed over the flame of a candle, the stone being traversed in a circle at a moderate distance above the flame, that it may be heated uniformly. If the stone were held stationary above the flame it would be liable to be cracked, from one portion being heated more rapidly than another. The usual test for the proper degree of heat, is the placing of the seal upon the naked hand, and if the heat is about as great as can be borne

by a tolerably sensitive hand without causing pain, it is considered to be suitable. The engraved surface of the seal is then coated with a very thin layer of clean tallow, applied with a small brush, such as a rather soft nail-brush, and the tallored surface is again coated with a thin layer of vermilion, applied with a camel's hair pencil. This completes the preparation of the seal, and when the impression is made the vermilion becomes attached to the surface of the wax, and materially heightens the beauty of the impression.

The sealing-wax is prepared by holding the stick of wax at a little distance above the flame of the candle until it is thoroughly softened; but it is only so far heated as is necessary to allow of a sufficient quantity of wax being detached to form the impression, and care is taken to avoid blackening the wax, either by smoke or allowing it to become ignited. The softened wax is deposited in a small heap on a piece of stout paper, and when enough to form the impression has been placed on the paper, the fusion of the wax is completed by traversing the under surface of the paper above the flame of the candle, at a sufficient distance to avoid scorching the paper.

When the wax has become thoroughly softened, it is stirred with a small stick to drive out all the air-bubbles, and work it into a uniform mass of a conical shape; the paper is then laid upon the table, and when the surface of the wax has become bright and quiescent, the seal is applied to give the impression. In order that both the seal and the wax may be at the requisite temperatures, the preparation of the two is carried on almost simultaneously, and usually the seal is held over the flame of the candle for a few seconds to restore the heat, while the wax is assuming the quiescent state.

In applying the seal to the wax, the seal-handle is held between the thumb and the first two fingers, applied as near to the seal as convenient. To give steadiness to the hand, the wrist is rested upon the surface of the table, and the position having been carefully determined, the seal is quickly dabbed upon the wax, with a firm perpendicular stroke, but only with moderate force. Some little practice is necessary to obtain sufficient dexterity to give the impression with precision; but the method of quickly dabbing

the seal upon the wax, yields far more defined impressions than the mode sometimes adopted of applying the seal with quiet but considerable pressure, which not only fails to copy the most delicate of the lines and angles, but the imperfect copy thus produced is also liable to be further deteriorated by the seal sliding on the gradually yielding wax, which then receives a double impression.

In this, as in similar processes, the most sharply defined impressions are produced by employing sufficient momentum to drive the wax at the same instant into all the minute crevices of the seal, exactly as in the clichée casting and type founding, alluded to at page 324, Vol. 1.

SAFETY-PLUG FOR BOATS AND VESSELS.

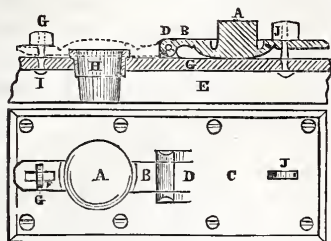
*Registered for Thomas Thompson, Esq.,
Commander R. N., Leith.*

THE recent fatal steamboat casualties—amongst which, the Clyde ship, "Orion," figures in a most conspicuous manner, in reference to the very point now before us—have at last aroused the attention of practical men to the strong necessity for more particular attention to the safety fittings of boats. The disclosures consequent upon the disasters to which we refer, have shown us, that, not unfrequently, the boats have had few claims to the character of life-preservers. The boring of holes through a boat's bottom, regardless of any provision for closing them in time of need, partakes of every thing that is absurd and disgracefully careless; and if the evidence of such gross negligence had not been particularly prominent, it would have been thought ridiculous for belief.

Commander Thompson's plan professes to deprive the most heedless man from sacrificing life in this way, for it provides an instant means of shutting up the plug-holes under any circumstances.

Fig. 1 of the engravings, represents a longitudinal sectional elevation of the "safety-plug," as fitted to the garboard strake in the well of a boat—the plug being open, whilst the dotted lines exhibit it in its closed state. Fig. 2 is a corresponding plan, with the plug closed down. A, is the conical plug, formed on the underside of the holding-lever, B, which is hinged to the metal plate C, at D,

the plate being fastened down upon the plank E. The front end of the lever, B, is slotted longitudinally at F, to admit the hasp, G, standing up from the plate, so that when the plug is shut down, it enters the socket, H, in the plate, and is firmly secured in position, by a tube of



the hasp, which is capable of revolving at I, in the plate, to bring the flat top of the hasp across the slot. To keep the plug open, and down out of the way, a second hasp is fitted at J, in the opposite end of the plate, C, to suit the position of the holding slot, when the lever is thrown back.

This fastener is always at hand, and as it cannot easily be injured, and will utterly prevent leakage, it must secure for itself very extensive adoption. The "Africa" (Cunard's line) steamer's boats are fitted with it.

MANUFACTURE OF ICE.

A writer in the London Mechanics' Magazine describes Dr. Gorrie's ice machine, and the results obtained from it. Can any one inform us why this machine has not been improved for use on board ships under the tropics?

To understand this machine, conceive of two vertical pumps, made precisely like steam engines—one of which is adapted to condense atmospheric air, so as to squeeze out of it a portion of its gaseous heat, and the other is constructed to admit of the expansion of the same air, connected with the extremities of a beam common to both, and you will form an idea of all that is indispensable to manufacture ice on this principle. It will be obvious to the slightest reflection, that as the air in expanding becomes a powerful absorber of heat, and will

greedily take it from all surrounding bodies, ice might be made by simply immersing the cylinder in which the expansion takes place in water. This process, however, would be too tardy a one for business purposes; and the operation, therefore, is prodigiously accelerated by various adjuncts. In the first place, in order that the free heat of the condensed air may be extinguished, so as to fit it for its highest degree of refrigerative effect, without any loss of time, a pump, connected also with the beam, but bearing a very diminished proportion in size to the air-pump, is made to inject a jet of cold water at and during every stroke of the machine. And so, a similar pump projects its measure of an uncongealable liquid among the expanding air in the other air-pump, so as to furnish it instantly with the caloric of volume, while the liquid itself becomes cooled at the same time from the heat it parts with. This liquid (a strong solution of salts) is withdrawn from a tank, or vessel designed for the accumulation of "cold," into which, after performing its duty in the expanding engine, it is again sent back through the eduction valves. In this tank the ice is manufactured by simply immersing water, placed in metallic vessels, in the liquid; or with the mechanical addition of occasionally breaking up the adhesions of the ice to the sides and bottom of the vessels, so as to present a new surface of water to the action of the external cold. The reservoir of cold, the expanding engine, the injection pump, and, indeed, every part of the apparatus employed in generating or preserving cold, are so thoroughly concealed from sight, and the radiating influence of the external air, by insulating chambers, that the processes going on within them are wholly unperceived.

It ought to be mentioned that the condensed air, instead of being transferred directly to the expanding pump, as the above description would imply, passes intermediately into a wrought-iron reservoir, large enough to store a considerable number of cylinder-fulls of air, and thus any disadvantage from leakage, or the unequal working of the pumps, is obviated.

There are other auxiliaries to the economical and perfect working of the apparatus, both in regard to the consump-

tion of power, and the production of refrigerative effects; but they are not indispensable to the principle, and are not easily explained. Indeed, the entire contrivance presents such an ingenious system of checks and balances, that none but a man well skilled in mechanical science, and endued with a thorough knowledge of the chemical and physical laws of air, under the conditions to which it is subjected, should presume to undertake its construction.

The result of the experiment made here, though conducted upon a very slight knowledge of the principles involved, is, if correctly reported, highly favorable to the usefulness and value of the invention. In comparison with the operation of the somewhat similar invention of our distinguished countryman, Sir John Leslie, it exhibits much more power. With pumps of about 8 inches in diameter, and of 16 inches stroke, condensing and expanding air to and from a tension of three atmospheres, a block of ice, weighing nearly 60 lbs., was produced by the labor of two men in two hours. At this rate, ice can be manufactured, within any part of the tropics, at a less price than can be imported. But on a larger scale, and with a cheaper power, the results would be found much more advantageous; and no doubt sufficiently so to enable ice to be sold at a price which would render it, as contended, accessible to the poorest classes.

There is found at Bilin, in Germany, a deposit of siliceous (flinty) character, which occupies a surface of great extent (probably the site of an ancient lake), and forms slaty layers of fourteen feet in thickness. This bed supplies the *tripoli* used by artisans in metal for polishing their work; and also the fine sand employed to form moulds for casting small articles in Berlin iron. For these purposes its consumption in Berlin alone is not less than from 50 to 60 cwt. yearly. It is almost entirely composed of the sheaths or coverings of a kind of animalculæ which has the power of separating flinty matter from the water in which it dwells, and of producing out of this a sort of case analogous to the shell of a crab or lobster. The length of one of these is about the 1.3500 of an inch; and it is hence calculated that about 23 millions of them are contained in a cubic line of the sand, and 41,000 millions in a cubic inch.

REVIEWS.

Footprints of the Creator. By HUGH MILLER. From the third English edition. Gould & Lincoln. Boston.

The Old Red Sandstone, or New Walks in an Old Field. By HUGH MILLER. From the fourth English edition. Gould & Lincoln. Boston.

We predict for these volumes a wide circulation in this country.

They are books for all readers.

The author of them was until recently a working mason, or rather *quarryman*, in Scotland. Compelled in early life to seek his bread by following an occupation the exercise of which requires less expenditure of intelligence perhaps than any other, yet this very occupation opened to him a field for thought and investigation which has been wrought by him in a manner few may hope to equal—none to excel.

With the poetry of these volumes we have nothing to do in this place, further than as it reminds us (and we would impress it upon our brother mechanics) that there is no homely truth which may not be rendered captivating by an earnest, enthusiastic method of narration.

"Shall these dry bones live?" is not in itself a lively text, but let such as are disposed to regard the investigation of fossil remains and geological eras as dry uninteresting speculation, read Hugh Miller, and our word for it, if there be one spark of the ethereal in their composition, it will manifest itself.

Annual of Scientific Discovery for 1851.

Edited by D. A. WELLS and GEO. BLISS. Boston.

This is the second yearly volume of a work, the value of which will scarcely be appreciated during the first few years of its existence. The growing necessity for such a record is obvious, and an index to the labors of our savans and mechanics is becoming a requisite in every library.

The Manufacture of Steel. A Hand-book for Blacksmiths and Workers in Steel and Iron, &c. By FRED. OVERMAN. A. Hart: Philadelphia. 1851.

An eminently practical work, and calculated to be of service to all who have to meddle with steel, either cold or hot. It embodies much information of the character otherwise only to be acquired by hard knocks.

It is recommended to our young mechanics as "sound."

Theory and Practice of Bridge Construction. By H. HAUPT.

This is without question the best practical work on timber bridges which has ever appeared from the press either of this country or of Europe.

For boldness of design and skill in execution, the American timber bridges are confessedly unrivalled. We know of no work before this in which their principles have been fully investigated and exhibited. And we predict for the work a reputation abroad at least. Unfortunately at home our bridge builders are too intent on inventing new forms to spare much time for the study of the principles of such as have been built. The Patent Office record abounds in projects for self-sustaining structures, the most of which have failed most signally in sustaining their inventors. We were once shown a bridge of some magnitude, completed and in use over a river, the strength of which we proved to the builder could be doubled by placing it *bottom upwards*.

A friend of ours tells of a workman to whom he was about intrusting a piece of mechanical work, but doubting his ability to properly proportion its parts, and expressing his doubts, was assured by the workman that he had two infallible rules by which he was guided in determining the dimensions of materials. The first was, "to take the average judgment"—the second, "guess and allow."

These rules are, or have been, of universal application in bridge building; but with all

becoming deference to the respectable class who have been accustomed to apply them, we would suggest that it is about time they learned a new set of rules, or still better—a few principles. To aid them, they cannot find a better book than Haupt's *Bridge-Building*.

PATENTS.

List of Patents (with claims annexed), which issued from the United States Patent Office from the 8th day of April, 1851, to the 22d April, 1851, both inclusive.

TO LEWIS FAGIN & HENRY C. HAYMAN, of Cincinnati, O., for *Improvement in Apparatus for Bolting Flour*. Patented April 8, 1851.—We do not claim the broad principle of bolting meal by an air blast, as this has been imperfectly done before. We claim the application of a blast cylinder, with spiral issues, as described, to the process of bolting flour or other pulverized material, by means of which, during a continuous blast, the meal is consecutively thrown against the bolting cloth, and so much as is not passed through at once, is given an interval of time to fall from the cloth, and leave open the meshes; and is thus, as it were, re-fed to the impulse of the blast from each succeeding issue; the intermittent action, at the same time, causing eddies that loosen, and, as it were, rip up the bran and flour from the cloth, separate the bran from the flour, and twirl the particles of bran in such a manner as to leave the flour free to pass through, while the bran, from the twirl thus given it, is caused to present its broadest surface to the bolting cloth, the specking of the flour being thereby prevented and avoided. We also claim the insertion of a set of beaters, at a suitable distance down the bolting cloth and blast cylinder, which, during the bolting process, shall interrupt the same at a time when the bran requires beating, in order to loosen the flour from it, preparatory to the further continuance of the bolting process. We also claim the chamber by means of which the light flour carried up by the escape of the blast is re-gathered and returned to the usual gathering chamber.

TO ELIAH S. HOPKINS, of Painesville, Ohio, for *Improved Saw-set*. Patented April 8, 1851.—I claim, first, supporting the lever by which motion is given to the jaws, by means of an adjustable stirrup; said stirrup serves as a gauge in addition to performing its ordinary duties. Second, I claim the arrangement of the jaws constructed of one bent piece of metal, with the lever and stirrup, the handle of said lever projecting backwards towards the rounded part of the jaws.

TO THOMAS J. SLOAN, of New-York, N. Y., for *Apparatus for setting up Ten-Pins*. Patented April 8, 1851.—I claim elevating the

pins in a bowling alley, by means of a set of elevating sockets, operated from the head of the table, when this is combined with any well-known device, or devices, which will permit the pins to fall, and sustain them in a vertical position after they are elevated.

To AARON D. CRANE, of Newark, N. J., for *Improvements in Horse Powers*. Patented April 8, 1851.—I claim the manner of arranging and connecting the whiffle-tree and brake, so that when the horse is drawing, the brake is off the wheel, or pulley, and when not, is on, and acting as a governor, as described.

To WM. TODD, of Stamford, Conn. (assignor to ATWOOD & KELLOGG, of Derby, Conn.), for *tool for making Jack Planes*. Patented April 8, 1851.—I claim the combination of the stud pins with the bending stud and holding dog, arranged and acting substantially as described.

To CELIA R. P. FOSTER, of Canandaigua, N. Y., for *Improvements in Ladies' Work Tables*. Patented April 8, 1851.—I claim the mounting of the upper leaf and disc, with the drawers on the rotary standard, thus raising or lowering the whole, to suit different persons, by a screw. I also claim the rotary disc with drawers hung thereon by the screw supported by the pin which can turn round the standard, and raised or lowered as described.

To ROSWELL T. MERRILL, of Bloomfield, Mich., for *Improvement in Grain Separators and Fans*. Patented April 8, 1851.—I claim constructing the elevator with double troughs, as described, for the purpose of preventing the grain from falling through between the cells. I moreover claim the combination of the elevator, wind channel, and plate valve, with a grain threshing and winnowing machine, the former being constructed and arranged as described.

To HIRAM STRAIT, of Covington, Ky., for *Improved Saw-set*. Patented April 8, 1851.—I claim the adjustable double bevelled slide saw-rest, constructed and used substantially as described, by means of which its bevelled bed, the tooth-rest, upper jaw and punch, saws of all kinds can be firmly held, and their teeth be either set in V form, shouldered in U form, or be both shouldered and set to any amount required, to insure any degree of smoothness or roughness in sawing, whether their points are sharp or rounded.

To JONATHAN L. BOOTH, of Chyahoga Falls, Ohio, for *Improvement in Winnowing Machines*. Patented April 8, 1851.—I claim the blast passages arranged and controlled by the shutter, in the manner and for the purposes set forth.

To RUFUS K. PAINE, of Cincinnati, O., for *Improvement in Cooking Stoves*. Patented April 8, 1851.—I claim the three air passages between the fire brick and the upper oven, the said passages receiving external air at the sides of the stove, and discharging it into the back flue, in combination with the damper and flues (seven), for the purpose of equalizing and regulating the heat to all parts of the ovens.

To OLIVER CLARK, of Medina, Ohio, for *Improvement in Scythe Fastenings*. Dated March 18, 1851.—I claim, first, making the shank of curved or arch form, longitudinally, as described, which enables it to be fitted to the snath, so as it may be set in or out, by giving it a slight motion in a curved direction. Second, the mode of securing the shank so as to admit of the edge of the blade being set up or down, by making the cavity in the projection, through which the shank passes, widest at the back, and making the back edge of the shank and the inner side of the tightening key, of corresponding arch form transversely, so that the shank may be held secure in any position.

To CHARLES A. BROQUETTE, of Rue Neuve, St. Nicholas, St. Martin, France, for *Improvement in material for transferring colors in Calico Printing*. Patented April 15, 1851.—I claim the use of extract of fibrine, to form with or without any other oily or fat matters, by the means which I have described, or any other equivalent means, a mastic adequate to thickening and retaining on fibres, threads, tissues, of every description and of every material or substance, the archil color, and such other colors as are incorporated with that mastic.

I also claim the above process of preparing and purifying the extract of cassine, in order by the means which I have specified, or any other equivalent means, to impart to fibres, threads and tissues, of vegetable nature of every description, by means of a preparation of mordant, the property of better uniting to or attracting the coloring matter of archil, and in general other coloring matters, either in printing or dyeing, whether this preparation or mordant be applied on the fibres or threads of vegetable nature, previous to the weaving, or whether it be applied after the weaving on tissues of vegetable nature, or on tissues composed partly of vegetable and partly of animal substances.

To JOHN BUCKINGHAM & JOSEPH H. BAIRD, of Watertown, Conn., (assignors to the Scovill Manufacturing Company of Waterbury, Conn.,) for *Improved Milling Tool*. Patented April 15, 1851.—The rotation die for making impressions on metals and other substances, is a well known instrument, and we make no claim founded on that instrument, in itself considered. But we claim the combination of such die with an axle, on which the same may vibrate, which axle is at right angles with the axis of rotation, and not in the same plane.

To E. T. HANON VALCKE, of Paris, France, for *Improvement in Mill Stones*. Patented April 15, 1851.—I claim constructing the running stones of mills with oblique apertures, or passages through the body of the stone, and provided with hoods or funnels, to collect the air during the rotation, and connected on the grinding face of the stone, with furrows, substantially as described, when this arrangement is combined with the use of vertical pipes leading from the extremity of one of the apertures or passages, to a funnel lead-

ing to the next succeeding oblique passage in the body of the stone for the purpose specified.

TO JOHN KRAUSER, of Reading, Pa., for *Improvements in Iron Railings*. Patented April 15, 1851.—I claim securing the railings permanently to the horizontal rods or bars of iron, for the purpose of constructing an entire section of railing by means of the methods of operating the rods or bars with the railings having jaws, recesses, and bearings, as described herein, and together with other devices in castings, termed saddles or troughs, having dovetails and tenons cast to them, for the purposes herein named, and this I claim, whether the several parts be formed and adapted to each other, and operated precisely as represented and described, or otherwise, the results always produced being effected by means equivalent to those within named.

TO RICHARD F. LOPER & JOHN W. NYSTROM, of Philadelphia, Pa., for *Improvement in the Steam Engine*. Patented April 15, 1851.—We claim, first, the construction and arrangement of the columns by which the steam cylinder is connected with the bed frame, in such manner that they constitute the air pump and condenser, as set forth. Second, the method herein described of actuating the cut-off valve of one steam cylinder, by a motion derived from the valve or valve rod, of the other cylinder, as set forth. Third, the adjustable supplementary valve in connection with apertures or ports in the steam valves, by means of which the steam can be worked at full pressure throughout the whole length of the stroke, without disengaging the cut-off valve.

TO JAMES S. MARSH, of Lewisburgh, Pa., for *Improvement in Cooking Stoves*. Patented April 15, 1851.—I claim the apertures and the passages by which the air containing the surplus heat from the oven is conveyed to the back of the fire chamber, where it receives an access of heat, and afterwards to the flues, by which arrangement the heat is equalized between the two ovens, and the upper one is ventilated as set forth.

TO S. S. PUTNAM, of Boston, Mass., for *Improvement in Window Curtain Fixtures*. Patented April 15, 1851.—I claim the method or means herein described, of fastening the confining bar in the groove of the roller in which the cloth is pressed; that is, by having the ends of said bar rebated as described, and fitting the caps at the end of said roller over said rebated ends of said bar, as above set forth; this arrangement of the caps and bar (the said caps, or one of them, being loose, so as to move laterally, but not to revolve, the side of the rebated ends of the bar operating as shoulders, to prevent a revolution) enables me to adapt my improved fixture to windows of different widths.

TO JOHN W. ROBBINS, of Camden, Ohio, for *Improvement in setting logs in saw mills*. Patented April 15, 1851.—I claim, first, the vibrating dog having the distance of its head or tongue, with respect to the saw, adjusted lat-

erally by a set screw, substantially as represented, so that by planing the tongue of the head, in each successive curf, and bringing the face of the log in contact therewith, the thickness of each consecutive board is exactly counterpart with the first. Second, I claim, for analogous purposes, at the rear end of the log, which is destitute of a curf, the vibrating dog, whose distance, in respect to the stationary block, is adjustable, by means of a set screw, the range between the head of the dog and the block affording an easy and determined means of giving exactly the same thickness to the boards, at the rear end of the log.

TO ABRAHAM D. SPOOR, of Troy, N. Y., for *Improvement in agitating Grate Bars*. Patented April 15, 1851.—I claim the application of the movable grate, of two separate mechanical movements, whereby it may receive a rocking or a vertical vibratory motion, at pleasure, and the several parts constructed as described.

TO ANDREW DENNISON, of Brunswick, Me., for *Machine for cutting out the corners and scoring the edges of paper for boxes*. Ante-dated April 4, 1851. Patented April 15, 1851.—I claim the combination of the knife and die, substantially in the manner and for the purpose herein described.

TO SAMUEL AVERY, of Phoenix, N. Y., for *Improvement in apparatus for operating window blind Slats*. Patented April 15, 1851.—I claim making the cog wheel with such a length of teeth that, when its spindle is forced outwards by the spring, they shall engage with the teeth on both sides of the cog wheel, F, thereby locking the same and securing the slats in any desired position.

TO HENRY HOFFMAN & CHARLES F. HILL, of New-York, N. Y., for *Improvements in Ornamenting Marble*. Patented April 15, 1851.—We claim the above described ink, and the wax color and etch water used in combination therewith as described.

TO DENNIS M. LITTLEFIELD, of Lowell, Mass., for *Improvement in Cooking Stoves*. Patented April 15, 1851.—I claim the peculiar arrangement or manner of combining the fire-place, the descending of diving flues, the ash-pit, the lateral chambers, the ascending flues, the central discharge flue, the oven or air-heating chamber, and its surrounding flue space, all as represented and specified.

TO JOHN WOOD and WM. W. WOOD, of Conshohocken, Pa., for *Improvement in the process of manufacturing glazed sheet iron*. Patented April 15, 1851.—We claim the employment of thick plates of iron as shield plates; or in other words, placing four (more or less) thin plates between two shield plates of double weight, in forming packs for rolling, so that each shield plate will make two plates of proper size to constitute the inside plates of another pack, for the smoothing and finishing process, or rolling.

TO JONATHAN BALL, of New-York, N. Y., for *Improvement in means of Renovating and*

Correcting Sight. Patented April 22, 1851.—I claim the cups and caps, to produce a pressure upon the periphery, in case of old age, or front of the eye, in case of near sight, which will increase or diminish its convexity, as the nature of the case may require, with their application as set forth, using for that purpose any of the materials named in the above specification.

To CHARLES W. GRANNIS, of Gowanda, N. Y., for *Improvement in Cooking Stoves.* Patented April 22, 1851.—I claim, first, the arrangement of the flues which conduct the heated air to the space under the oven bottom, from which it is discharged into the oven at the corners thereof, and without any enlargement to permit the expansion of the air before it reaches the oven, as described, when this is combined with the arrangement of fire flues on each side thereof, as described; whereby the air, passing to the oven, is heated along the whole distance of its passage, by the products of combustion from the fire place. I also claim the heating of the air in its passage through the back hot-air chambers, by combining with such air chambers and the main fire flues, the branch fire flues which pass back of the said air chamber.

To JAMES REYNOLDS, of New-York, N. Y., for *Improvement in Machines for Gutta Percha Tubing and covering wire.* Patented April 22, 1851.—I claim the use, for the purposes specified, of feed rollers, in combination with the stomach, having a lip or mouth arranged and operating substantially as described.

To BRADFORD ROWE, of Albany, N. Y., for *Improvement in Machines for Stretching Leather.* Patented April 22, 1851.—I claim the method or device of stretching leather, especially for belting, by the use of apparatus so arranged that after a piece of leather has received, by an equable strain applied to its ends for their whole width, the proper stretch that the material can bear on or along one edge thereof, if it be found that the other edge and parts intermediate between it and the first edge (from the difference in quality of fibre), has not received proper tension, the further stretching of the first side shall be stopped, whilst, by the application of the mechanical stress, at the other edge of the leather, it, and the parts between it and the first side, shall be duly stretched, substantially in the manner set forth. I claim the holding boards as essential, in all leather stretching apparatus, where it can be applied in keeping the material, whilst being stretched, from contracting in width and becoming defective thereby. I claim the holding board, with its clamps and wedges, in combination with the apparatus for stretching, for the uses and purposes substantially as set forth.

To CHARLES W. STEARNS, of Springfield, Mass., for *Improvement in Clogs or Pattens.* Patented April 22, 1851.—I claim the application of an elastic loop or strap attached to the sole piece and going around the heel.

To WM. STREVELL & DANIEL BROWN, of Albany, N. Y., for *Improvement in Machines for Stretching Leather.* Patented April 22, 1851.—We claim the construction of the stretching apparatus, by connecting the free rod to the clamp, by entering the end or tenon of the rod into a mortise with angular sides, and securing them together by a pivot pin.

To WM. CLAY, of Clifton Lodge, England, for *Improved apparatus for rolling tapered Metallic Rods.* Patented April 22, 1851. Patented in England Dec. 16, 1848.—I claim permitting the rollers to recede from each other, by means of the hydraulic apparatus, constructed and arranged substantially as described. And secondly, the adjustable screw in conjunction with the apparatus claimed above, whereby bars of metal are enabled to be rolled taper for a portion of their length, and parallel for the remaining part thereof.

To LEMUEL HEDGE (assignor to George W. Hedge), of Brooklyn, N. Y., for *Improvement in Saw Mills.* Patented April 22, 1851.—I claim the method of driving belt saws by the friction surface of two cylindrical pulleys, or drums, which gripe the saw plate below the wood which is being cut, but at some parts of its tangent line, so that the strain to which it must be subjected in cutting, to keep it in the line of the tangent, shall not be at any part of its curved path; but this I only claim in combination with straining rollers, which gripe the saw above the lumber on which it acts, the said rollers being controlled by a brake or the equivalent thereof, whereby the saw, during its action, is kept in a strained condition along its entire line of action, that it may cut in a straight line, and to avoid its being under tension when the flexions take place along the curved portions of its track. I also claim, in combination with the mode of driving a belt saw by means of cylindrical rollers or pulleys, the employment of a belt passing around the outer one of the said driving rollers, and applied to the outer surface of the saw, where it passes around the lower deflecting or guide pulley, by means of which the saw is bent by the pressure of the belt applied to its outer surface, instead of being communicated through the metal itself, thus avoiding, in a great measure, the tendency to break the metal. And finally, I claim, in combination with the mode described, of driving a belt saw, the employment of fenders or scrapers, interposed between the driving rollers and the wood to be sawed, and placed each side of the saw, to catch the sawdust and conduct it away from the sight of the driving rollers or the saw, and thus avoid clogging.

To EDWARD WHITELEY, of Boston, Mass., for *Improvement in Coffee Roasters.* Patented April 22, 1851.—I claim the combining or arrangement of the fire place or chamber of combustion, the roasting cylinder, and its surrounding chamber. Also the arrangement of the flue of the fire chamber with respect to the latter, and the inclosing chamber

of the roaster, the said arrangement of the said flue consisting in carrying it over and in contact with the top of the said inclosing chamber. I also claim the arrangement of the proving tube, within the hollow journals and central part of the roaster; not meaning to claim the device termed the proving tube, but simply the arrangement as specified.

To TAZWELL F. WINGO, of McLemoresville, Tenn., for *Improvement in Straw Cutters*. Patented April 22, 1851.—I claim the manner of arranging one or more cutters on the periphery of a vertical wheel, at such angle with, and so extending over the face of said wheel, as will give a "drawing cut" through the straw or other material, as it falls, to the opposite side of the wheel from where it is cut, thus removing the cut material out of the way of the feeding box and uncut material.

To R. STILWELL, of New-York, N. Y., and E. L. BRUNDAGE, of Troy, N. Y., for *Improvement in Car Seats*. Patented April 22, 1851.—We claim the mode of reversing the back of car seats from one side of the seat to the other, without turning them over, by means of arms constructed and arranged as set forth, by which any desired height of back is obtained. Secondly, we claim the manner herein described, of reversing the concave back on a moveable frame, in combination with the side locking projections.

To JAMES R. BUGBEE, of Boston, Mass., (assignor to James R. Bugbee & Enoch Robinson, of Somerville, Mass.,) for *Improved Lock and Key*. Patented April 22, 1851.—I claim the wedge or cam key and the separate bitt, or secondary wedge or cam key, in combination with the vibrating block, the key recess and the tumbler elevators; the whole being constructed, arranged and operating substantially as specified.

To JEHU HOLLINGSWORTH, of Zanesville, Ohio, for *Improvement in Smut Machines*. Patented April 22, 1851.—I claim the manner of scouring and freeing wheat of smut and other impurities, by throwing up the grain on to the inclined face of a chimney, fitted to an opening along the top of the concave, in combination with the inclined aprons, for transferring the grain from end to end of the cylinder, that it may be discharged.

Designs.

To SETH WILLIAMS, Jr., of Nashua, N. H., (assignor to Williams, Bird & Co., of North Chelmsford, Mass.,) for *Design for Stoves*. Patented April 8, 1851.

To SAMUEL W. GIBBS, of Albany, N. Y., (assignor to Jagger, Treadwell & Perry, of Albany, N. Y.,) for *Design for Stoves*. Patented April 8, 1851.

To DUTEE ARNOLD, of Providence, R. I., for *Design for Cooking Stoves*. Patented April 15, 1851.

To JOHN ABENDROTH, of Port Chester, N. Y., for *Design for Cooking Stoves*. Patented April 15, 1851.

List of English Patents issued from Feb. 18, 1851, to March 18, 1851.

Henry Richardson, of Aber Houran Balor, North Wales, esquire, for certain improvements in life-boats. February 22; six months.

William Stones, of Queenhithe, London, stationer, for improvements in the manufacture of safety-paper for bankers' cheques, bills of exchange, and other like purposes. February 24; six months.

Edward Lloyd, of Dee Valley, near Corwen, Merionethshire, North Wales, engineer, for certain improvements in steam-engines, which improvements are in part or on the whole applicable to other motive engines. February 24; six months.

Peter Wood, of the firm of Bury & Co., dyers, finishers, and calenderers, of Salford, Lancaster, for improvements in printing, staining, figuring, and ornamenting woven and textile fabrics, wood, leather, or any other material substance or composition, and in machinery and apparatus employed therein. February 24; six months.

John Hinks, of Birmingham, manufacturer, and James Vero, of Burbage, Leicester, manufacturer, for certain improvements in the manufacture of hats, caps, bonnets, and other coverings for the head. February 24; six months.

Gabriel Didier Fevre, of Paris, France, gentleman, for certain improvements in apparatus for manufacturing and containing soda-water, and other gaseous liquids, and also in preserving other substances from evaporation. February 24; six months.

Thomas Wicksteed, of Old Ford, Middlesex, civil engineer, for improvements in the manufacture of manure and in machinery to be used therein. February 24; six months.

Robert Adams, of King William-street, London, gun-maker, for improvements in rifles and other firearms. February 23; six months.

Francis Clark Monatis, of Earlston, Berwick, builder, for an improved hydraulic syphon. February 23; six months.

Isaac Lowthian Bell, of Washington Chemical Works, near Newcastle-upon-Tyne, chemical manufacturer, for improvements in the manufacture of sulphuric acid. February 23; six months.

Henry Dircks, of Mooregate-street, London, engineer, for improvements in the manufacture of gas, in gas-burners, and in apparatus for heating by gas. February 23; six months.

Charles Frederick Bielfeld, of Wellington-street North, Strand, paper maché manufacturer, for improvements in the manufacture of sheets of paper maché, or substances in the nature thereof. February 24; six months.

Samuel Cunliffe Lister, of Manningham, near Bradford, York, for improvements in preparing and combing wool and other fibrous materials. February 24; six months.

Robert Hawthorn and William Hawthorn, of Newcastle-upon-Tyne, engineers and partners, for improvements in locomotive engines, parts of which are applicable to other steam-engines. February 24; six months.

Amedée François Remond, of Birmingham, gentleman, for improvements in the manufacture of metallic tubes or pipes, and the machinery or apparatus connected therewith, which improvements are applicable to other like purposes. February 26; six months.

Thomas Ellis the elder, of Tredegar Iron-works, Monmouth, engineer, for certain improvements in machinery or apparatus to be employed in the manufacture of blooms or piles for railway and other bars or plates of iron. February 27; six months.

William Millward, of Birmingham, plater, for certain improvements in electro-magnetic and magneto-electric apparatus. February 28; six months.

Charles Felton Kirkman, of Argyle-street, gentleman, for certain improvements in machinery for spinning and twisting cotton, wool, or other fibrous substances. February 28; six months.

Henry Willis, of Manchester-street, Middlesex, organ-builder, for improvements in the construction of organs. February 28; six months.

James Leach, of Littleborough, Lancaster, cotton spinner, for certain improvements in machinery or apparatus for carding, spinning, doubling, and twisting cotton and other fibrous substances. February 28; six months.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in portable bedsteads, and in sacking bottoms. (Being a communication.) February 28; six months.

William Milner, of Liverpool, Lancaster, safety-box manufacturer, for certain improvements in boxes, safes, or other depositories for the protection of papers or other materials from fire. March 3; six months.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman, for improvements in the preparation of materials for the production of a composition or compositions applicable to the manufacture of buttons, knife and razor handles, in inkstands, door-knobs, and other articles where hardness, strength, and durability are required. (Being a communication.) March 4; six months.

Peter Armand Lecomte de Fontainemoreau, of South-street, Finsbury, patent agent, for improvements in compressing air and gases for the purpose of obtaining motive power. (Being a communication.) March 10; six months.

Victor Hyacinthe Libert Guillouet, of Condé Sin Noiroi Calvadot, France, chemist, for certain processes for increasing on manufactured fabrics the several shades of indigo. March 10; six months.

Elijah Galloway, of Southampton-buildings, Chancery-lane, Middlesex, civil engineer, for improvements in steam-engines. March 10; six months.

Henry Alfred Jowett, of Sawley, near Derby, engineer, for improvements in railway breaks and carriages. March 10; six months.

George Robins Booth, of Portland-place, Wandsworth-road, Surrey, for improvements in generating and applying heat. March 10; six months.

James Murray, of Canterbury, Kent, barrack-master and captain, for improvements in saddlery and harness. March 10; six months.

Jean Baptiste Alphonse Brunet, of Paris, France, gentleman, for improvements in the manufacture of coverings for roofs, walls, partitions, furniture, and other similar articles, and in boxes, tubes, and other hollow articles, and in the preparation or manufacture of materials to be employed for such purposes, and also in machinery to be employed in such or similar manufactures. (Being a communication.) March 10; six months.

Thomas Horn, of Stanhope-street, May Fair, upholder and decorator, for machinery or apparatus for cleansing carpets, matting, and similar fabrics. March 10; six months.

George Roberts, of Selkirk, manufacturer, for an improved manufacture of certain yarns of linen, wool, silk, cotton, or other fibrous substances. March 10; six months.

William Galloway and John Galloway, of Manchester, engineer, for improvements in steam-engines and boilers. March 10; six months.

Jesse Ross, of Victoria-terrace, Keighley, York, gentleman, for certain improvements in machinery and other apparatus for combing wool, and other suitable fibrous substances, and in applying or working the same. March 13; six months.

Thomas Dawson, of Milton-street, Euston-square, machinist, for an improved method of constructing umbrellas and parasols. March 13; six months.

George Little, of New Peckham, electro-telegraphic engineer, for improvements in electro-telegraph, and in various apparatus to be used in connection therewith, part of which improvements are also applicable to other similar purposes. March 14; six months.

Herbert Taylor, of Cross-street, Finsbury, Middlesex, merchant, for certain improvements in the manufacture of carbonates and oxides of barytes, and strontia, sulphur, or sulphuric acid, from the sulphates of barytes and strontia, and for consequent improvements in the manufacture of carbonates

and oxides of soda and potassia. March 15; six months.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., of Fleet-street, London, patent agents, for an improved method of manufacturing screws. March 15; six months.

Herbert Minton, of Hart's-hill, Stafford, gentleman, and Augustus John Hoffstaedt, of Bridge-street, Blackfriars, London, gentleman, for improvements in the manufacture of faces or dials for clocks, watches, barometers, gas-meters, and mariners' compasses, or other articles requiring such faces or dials. (Partly a communication.) March 17; six months.

Alexander Robertson, of Holloway, Middlesex, engineer, and James Glover, of the same place, roller, for improvements in the rolling and laminating of metals, and in the manufacture of metallic cases and coverings. March 20; six months.

James Hart, of Seymour-place, Middlesex, for improvements in the manufacture of bricks, tiles, and other articles made from plastic materials, and in the means of making parts of the machinery used therein. March 17; six months.

Henry Bessemer, of Baxter-house, Old St. Pancras-road, Middlesex, engineer, for improvements in the manufacture and refining of sugar, and in machinery or apparatus used in producing a vacuum in such manufacture, and which last improvements are also otherwise applicable for exhausting and forcing fluids. March 20; six months.

Matthew Herring, of Tonbridge-place, London, sugar planter, for improvements in the manufacture of sugar and rum, part of which improvements are applicable to evaporation generally. March 24; six months.

Frederick William Mowbray, of the borough of Leicester, gent., for improvements in machinery for weaving. March 24; six months.

George Guthrie, of Appleby, chamberlain to the Earl of Stair, and residing at Rephad-by-Shanraer, Wigtown, for improvements in machinery for digging, tilling, or working land. March 24; six months.

Thomas Hill, residing at Langside-cottage, near Glasgow, esquire, for improvements in wrought iron or malleable iron railway chairs. (Being a communication.) March 24; six months.

Peter Armand Le Comte de Fontainemoreau, of 24 Boulevard Poissonnière, Paris, France, and 4, South-street, Finsbury, patent agent, for certain improvements in mills for grinding wheat and other grain. (Being a communication.) March 24; six months.

Henri et Alexandre Six, of Wazaume les Lille, temporary of Paris, France, gentleman, for improvements in bleaching flax and hemp. March 24; six months.

Hector Ledru, of 28 Faubourg Poissonnière, at Paris, France, civil engineer, for improvements in heating. March 24; six months.

James Cheetham, junior, of Chadderton, near Oldham, Lancaster, cotton manufacturer, for certain improvements in the manufacture of bleached, colored, or partly-colored threads or yarns. March 24; six months.

David Farrar Bower, of Hemslet, York, manufacturing chemist, for certain improvements in preparing, rating (otherwise called rotting), and fermenting flax, hene, grasses, and other fibrous vegetable substances. March 24; six months.

Edward Dunn, of New-York, in the United States of America, but now residing at Montpelier-square, Brompton, master mariner, for improvements in reciprocating and rotary fluid meters. (Being a communication.) March 24; six months.

Samuel Holt, of Stockport, Chester, manager, for certain improvements in the manufacture of textile fabrics. March 24; six months.

Samuel Walker, junior, of Birmingham, manufacturer, for a certain improvement or certain improvements in the manufacture of metallic tubes. March 24; six months.

Thomas Hawkins, of Inverness-terrace, Bishop's road, Bayswater, oilman, for improvements in brushes. March 24; six months.

Henry Stephen Ridley, of Vincent-square, Westminster, surveyor, and James Edser, of St. James's-terrace, in the said city, builder, for a safety hinge and certain apparatus for the detection of burglars and prevention of burglaries. March 24; six months.

Thomas Wood, of Portsea, Hants, upholsterer, and Robert Walter Winfield, of Birmingham, Warwick, manufacturer, for certain improvements in bedsteads and couches, or articles for sitting, lying, and reclining upon. March 24; six months.

CORRESPONDENCE.

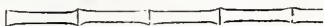
MANCHESTER, April 24, 1851.

Editor Appletons' *Mechanics' Mag.*

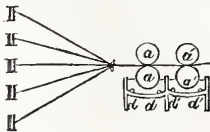
DEAR SIR:

I stated in my last, that I should take up the question of the new discoveries in flax-spinning in my present letter, and I am accordingly obliged to say, that it is pretty well established that they are futile. To form a clear idea of the reasons why they are so, let me call your attention to the form of the various fibres used for textile fabrics, as established by microscopical investigation, and I shall refer you to Dr. Ure's works on "the Philosophy of Manufactures," and "the Cotton Manufactures," for engravings to illustrate my remarks.

The fibre of flax has been ascertained to be a round, tubular, jointed substance, very much in form like a stalk of sugar-cane, giving a circular section, thus ; and a longitudinal section, thus:

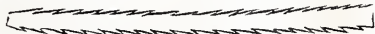


The fibre of cotton is as different as possible, being a flat ribbon with thick edges, and slightly contorted and twisted, giving a cross section, thus, much like a double-headed railway bar. Now, the thick edges, and the natural torsion of the filament, give it properties for clinging and twisting, which the fibre of flax has not in its perfect state, and is no more susceptible of, when split and broken, as the result would be only to make a filament like a "fence-rail," being a section of a circular fibre, thus:  where a may be taken as the fragment. B as the original fibre. Now, the plan of the Chevalier Claussen, as I understand it, produces this result. He proposes to saturate the fibre with an alkaline solution, and then by immersion in acid to generate carbonic acid gas in the interior of the tubular fibre, which is by its expansion to split said fibre and destroy its tubular form. The result has proved, that the destruction of the original form proved also the destruction of the strength and durability of the fibre, and only give you an uneven and broken substance, possessing neither the strength of flax, nor the equality and kindness of cotton, and so little is thought of it here, that all the shops are very



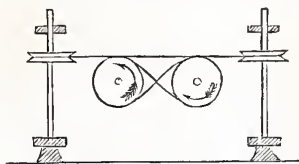
as the "tape-dressing machines," in which the warp passes through squeeze-rollers, *a a'*, in the boiling size, and is then dried over steam-rollers, *b b'*, of tinned iron, and wound on to the warp-beam, *c*; the size is kept hot by steam pipes, *d d'*, passing through the bottom of the size troughs, and the result of the system is, that it enables them to use much poorer

busy in building flax-spinning machinery on the old plan, for the business is receiving a vast increase in its legitimate manner, and is certainly a branch of manufacture which should be taken up in America at the present moment, if we consider the amount raised for seed every year in New-York and Ohio. It is as much reduced to a system and done by machinery as the cotton manufacture, and now offers one of, if not the very largest openings in America, for we import every year manufactures of flax to the amount of some \$6,000,000. The fibre of flax is equally ill adapted to the purpose of felting, a property which has been claimed for the new "discovery," as the felting property of wool and hair is solely owing to its being furnished with hooks on the fibre, giving it a longitudinal section, thus:

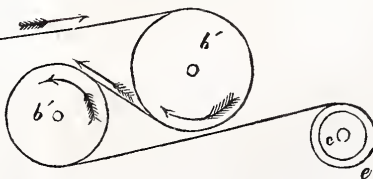


a result which can never be obtained from the fibre of flax, split and break it as much as you will. However, the thing is done for the present with all sensible men here, and I will turn from it to the subject of the cotton manufacture, which is in some respects in advance here of anything I know in America. England has, however, one advantage over the New England States, in her moist, non-electrical, and equable climate, enabling manufacturers here to work with ease into '80 and '100, such cotton as is used in Lowell for '40. I do not find the machinery used for the preparation of the cotton to differ much from what we use, but think that more care is taken in mixing and assorting the different varieties. The cards on all numbers under those I have mentioned, are now built with "workers and strippers," "top flats" being entirely abandoned; by this means less waste is made, the card being covered by "flaps" hinging at the extreme top, and falling fore and aft over the card. They also save much time and labor in stripping and cleaning. So far as the spinning goes, we have in America samples of all the machines in use here, the favorite mules being those of Sharp, Roberts & Co., and Parr, Curtis, & Madeley.

I saw at the mill of Messrs Kershaw, Leese, & Co., at Stockport, the other day, an improved throstle, the spindles being driven by two drums, each driving across the top of the other, and thereby



carrying the band perfectly true to the whorl on the spindle, and saving, as the manufacturer told me, 30 per cent in friction, power, and wear and tear. The dressing-frames now used, are what are known



cotton for warps than can be done by the old "brush-dresser." The looms have several variations from our common plan, enabling them to run at much higher speed, and which I will describe more minutely in my next letter, as I have not time now to go into the details. Suffice it for the present, that I saw the other day, girls tending three looms each, at a speed

of 165 picks per minute. I shall go up to London on Tuesday next, to see the opening of the Great Exhibition, and will write you an account of it, *if possible*, by the next steamer. I will endeavor to give you pretty full details of the novelties which will be on exhibition there, but am very sorry that our friends have neither sent over a locomotive or a fire-engine—two things which would show well.

Yours, &c.

ENGINEERS' INSTITUTE OF THE CITY OF NEW-YORK.—This important Institution, we are pleased to learn, have taken steps to become an incorporated body.

Its objects are, to instruct Mechanics in their trade and profession; to inform the young Artisan of the progress made in the Mechanic Arts, and to institute a place of resort for the working-men of the city of New-York during their hours of leisure.

Books, drawings, designs, engravings, &c., are provided for the use of the members. Lectures on all Mechanical subjects will be given at stated times, and classes instituted in Drawing and Mathematics.

The terms of admission are such as to bring its advantages within the reach of all who may be disposed to avail themselves of the facilities afforded for the acquisition of mechanical knowledge; and it is an evidence of the proper appreciation of such studies, that this Institution, yet in its infancy, (instituted Oct. 1849,) has already received encouragement which bids fair to place it, ere long, among the important institutions of this country.

OFFICERS FOR THE YEAR 1851.

President. Edward Faron.

V. Pres'ts. Wm. H. Lindsay; Henry C. Mason.

Recording Secretary. M. Brady, Jr.

Treasurer. John B. Moore.

Recording Secretary. George P. Clarke.

Board of Trustees under the Act of Incorporation.—The above named officers, and three members from the general body, not acting otherwise as officers or as members of any standing committee:

Thos. H. Faron; Nich. Fitzmorris; John Torrence.

The Library, Reading and Drawing-Rooms of the Engineers' Institute, are now open at No. 151 Bowery, corner of Broome-street.

"C. D." is received. We think him rather hasty in his judgment; but if, upon sober second thought he sees no occasion to change his views, we will put him in type.

"H. J." & "W. B. Stearns."—We have had several notices from correspondents, questioning the accuracy of our statement in the May Number of the Magazine in reference to a general formula for calculating excavations of earth-work. One, in particular, says that if it be accurate to divide a solid into the elementary forms of cube, prism, wedge, &c., it is equally so to construct a *general* formula, which is supposed to include in its expression but these forms.

Our young friends mistake us entirely. Any solid, however irregular, may be *approximately* determined by its subdivision into the regular solids. But any solid, however irregular, does *not* admit of a general expression, by which all irregular solids may be determined; that is to say, within the limit of practical usefulness.

"H. F. S.," *Williamsport, Pa.*, is received, and will be inserted.

LOCOMOTIVE EXPLOSION.—A few days since, a new engine, while under trial in the workshop of Rogers, Ketchum & Grosvenor, in Paterson, N. J., exploded, and killed five men and wounded others. Cause—the old story—want of water. At least, so says the coroner.

That this lack of water in a boiler is a fruitful source of mischief, there can be no doubt, but that *all* boilers explode from this cause we do not believe.

The comfortable satisfaction with which this verdict is frequently given and received, reminds us of an old engine-man we met on the Ohio river a few years since. We asked him the occasion of the numerous explosions on the river. "I will tell you," said he, "for I *know*, having run the river for twenty years—it's the same thing as thunder and lightning."

MINOT'S ROCK LIGHT-HOUSE.—It seems that our surmise of a fissure in the Rock, occasioning the failure of this structure, proves incorrect.

We gather from the official report made to the Engineers' Department at Washington, that the unwarrantable liberty taken of covering in a portion of the building with plank, as well as other obstructions appended to it, have been the occasion of at least hastening, if they were not in truth the sole cause of its failure.

NEW-YORK AND ERIE RAILROAD.—This great work is at length completed, and opened to the public under highly flattering auspices, and we are now dwellers on the shores of Lake Erie.

Our invitation to participate in the interesting ceremony of the formal opening of the Road did not, we regret to say, reach us in season to enable us to avail of the kind intentions of the gentlemanly Board of Directors, so repeatedly manifested during the several years we had the pleasure of being associated with them on this great work.

We here acknowledge our obligations for their kind thoughtfulness, the more that it was unexpected on our part. For, although it be well known that we possess the strongest possible interest in the success of this work, inasmuch as the most prominent structures on the line of Road (we allude to these facts, we hope, with becoming modesty,) were projected by ourselves; yet these trifling circumstances are usually so soon forgotten, that it was truly refreshing to find, in the present case, that some men may bear a temporary elevation, without entirely forgetting the courtesy due those humbler in rank.

APPLETONS'

Mechanics' Magazine and Engineers' Journal.

VOL. I.]

TUESDAY, JULY 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New-York.

[No. 7.

CUTTING'S SPARK ARRESTER.

Fig. 1.

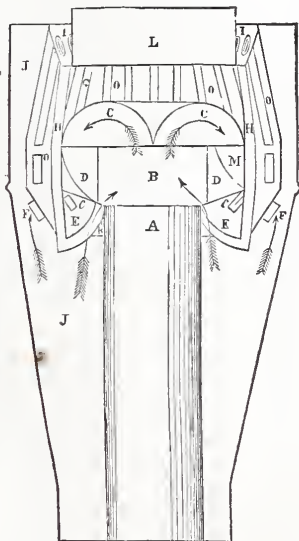


Fig. 4.

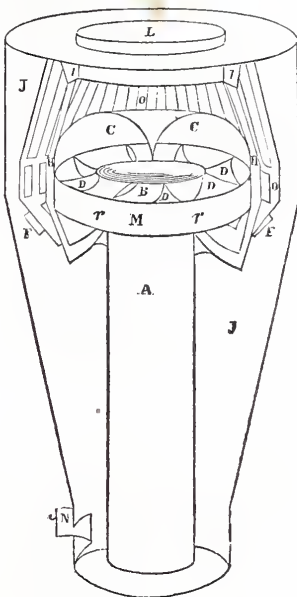


Fig. 2.

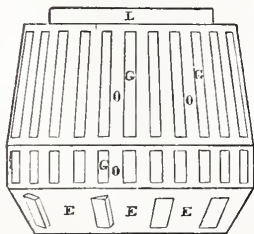
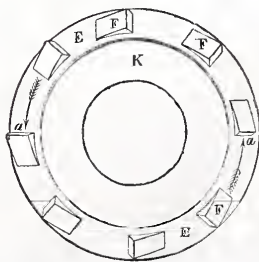


Fig. 3.



CUTTING'S SPARK ARRESTER.

Patented May 6th, 1851.

Figure 1, is a vertical section of the machine.

Figure 2, a view of the diaphragm with its curved and inclined planes, separating the outer chamber from the inner chambers, and exhibiting a view of the ventilators, or air flues, in the lower or inclined section.

Figure 3, is a horizontal view of the under side of Fig. 2, showing a series of ventilators or air flues, and the curved plane.

Figure 4, is a perspective view of a section, showing the combination of the different parts.

Fig. 6.

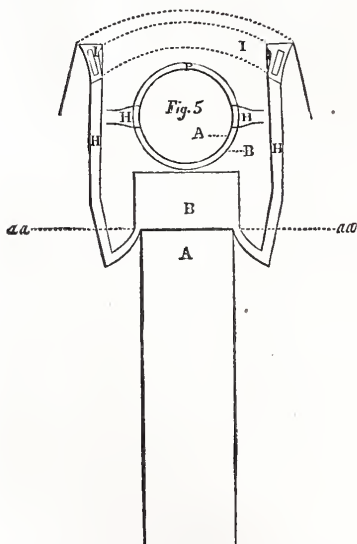


Figure 5, is a horizontal view taken at the line *a a*, of Fig. 6, showing the air flue, and the entrance of the ventilating tubes.

Figure 6, is a vertical section of the chimney in combination with the ventilating tubes and air chambers.

The same letters in the several figures represent the same parts.

The nature of the first part of my invention consists in arranging upon the outside of the inclined plane at the base of the diaphragm, a series of air flues,

extending from the spark chamber through the diaphragm, the mouths of said flues being in the spark chamber, and their exits in the diaphragm, so that the rotary current of steam, &c., through a series of curved flues in said diaphragm will pass over the exits of said air flues, causing a current of air to be drawn from said spark chamber through said air flues in the direction of the current of steam, &c., for the purpose of creating a partial vacuum in said spark chamber into which the sparks fall. And in order to effect the deposit of such light particles as may possibly reach the top of the diaphragm, the nature of the second part of my invention consists in arranging an air chamber within the diaphragm at the top of the stack, which chamber is ventilated or exhausted by means of tubes connecting that chamber with the air flue at the bottom of the chamber at the top of the chimney.

To enable others skilled in the art to make and use my invention, I will proceed to describe the same with reference to the drawings.

At the top of the chimney *A*, I place an air chamber *B*, over which I place a deflecting cone *C*, in the form of a funnel, with the outer edges turned down all around uniformly, to reverberate the steam, gases and particles, and throw them into a series of curved and inclined flues *D*, surrounding the air chamber *B*, by which a whirling or rotary motion is produced within the diaphragm *O*. This diaphragm is provided with a series of apertures *G*. The exhaust steam in passing through the chimney *A*, into the air chamber *B*, has the effect of drawing a current of air between the curved planes, and the chimney *A*, through the air flues *F*, out of the spark chamber *J*.

The air flues *F*, are arranged on the outer side of the inclined plane *E*, at the base of the diaphragm, and extend from the chamber *J*, through the diaphragm *O*. The mouths of the flues *F*, are in the spark chamber *J*, and their exits *C*, in the diaphragm *O*, the current of air through them being in the direction of the current of steam, passing through the inclined flues *D*,

as shown by the arrows, so as to allow the air to pass out from, and prevent the sparks, &c., from passing into the spark chamber through said flues F.

At the bottom of the diaphragm o, under the series of curved and inclined flues D, is a curved plane K, and an inclined plane E. In the inclined plane, E, is placed the series of flues F, above described. The effect of the passage of the circular current of steam, &c., within the diaphragm o, and over the air flues F, is to still further exhaust the spark chamber J, of its air, on the same principle that the spark chamber J, is ventilated by the passage of steam, &c., over the air flue P (shown by dotted lines in fig. 6), at the bottom of the air chamber B.

The circular current has the tendency by its centrifugal force to throw the particles off in a tangent, against the inner walls of the diaphragm o, and through the apertures G into the outer, or spark chamber J. The deposit of the sparks, &c., in the spark chamber J, is greatly facilitated by the action of the partial vacuum in the spark chamber J, by which a draft is occasioned through the apertures G of the diaphragm o, towards said spark chamber J.

It will be seen that the spark chamber J is exhausted of its air, in part, by every pulsation of exhaust steam, consequently between every pulsation there will be a draft toward the spark chamber J through the air flue as well as through the aperture G of the diaphragm o. This draft through the air flue toward the spark chamber J, will have the effect to create a draft upward through the chimney A, by which the draft of the furnace will be to a great extent regulated, and the heat correspondingly increased.

Figure 6, represents the chimney A, with air chamber B, in connection with the pipes H, which pass to another air chamber I, at the top of the stack. The passage of the steam through the chimney A, tends to draw a current of air through the pipes H, in the same manner in which the ventilation of the spark chamber J is effected, the result of which is to exhaust the air chamber I, of a portion of its air. This air chamber I, is provided with apertures, the object of which is to arrest such

light particles as may possibly reach the top of the stack, and cause them to pass around again with the view of their being deposited. L is the general outlet of the steam and such gases as may be evolved.



CLAY'S IMPROVEMENT IN ROLLING IRON.

We copy from the inventor's specification.

My invention of certain improvements in machinery for rolling iron or other metals, is designed to produce by the process of rolling, bars of taper forms, as for instance wedge-shaped bars or conical bars.

The tapering of metal bars I effect by allowing one of the shaping rollers to recede gradually from the other, as the rolling operation goes on, and thus enlarge the space or distance between the rollers, whereby the metal, in passing between them, is made to assume a gradually increasing thickness either in a wedge, conical, or other form, according to the shape of the grooves cut in the rollers.

My invention consists in the adaptation to rolling machinery, of pistons bearing against confined columns of water, or other non-elastic fluid, the ends of the piston rods maintaining or affording the means of keeping the bearings of the rollers from shifting their positions, excepting as the columns of water are allowed to relax their resistance by a slow and gradual escape of the fluid from the cylinder, or chamber, through an adjustable valve. The apparatus I have arranged for this purpose, is shown in the accompanying drawings, in which Fig. 1, represents a vertical section taken transversely through the head of one of the standards, wherein the bearings of the journals of the rollers are mounted, showing the piston, its rod and appendages, with the column of water against which the piston bears, and the valve whereby a small quantity of the fluid may be allowed gradually to escape. Fig. 2, represents a partial front view of the rollers, the bearings and part of the regulating apparatus in the head of the standard, being shown in section.

Of course it will be understood, that two such standards support the ends of the rollers. Fig. 3, is a horizontal sec-

Fig. 1.

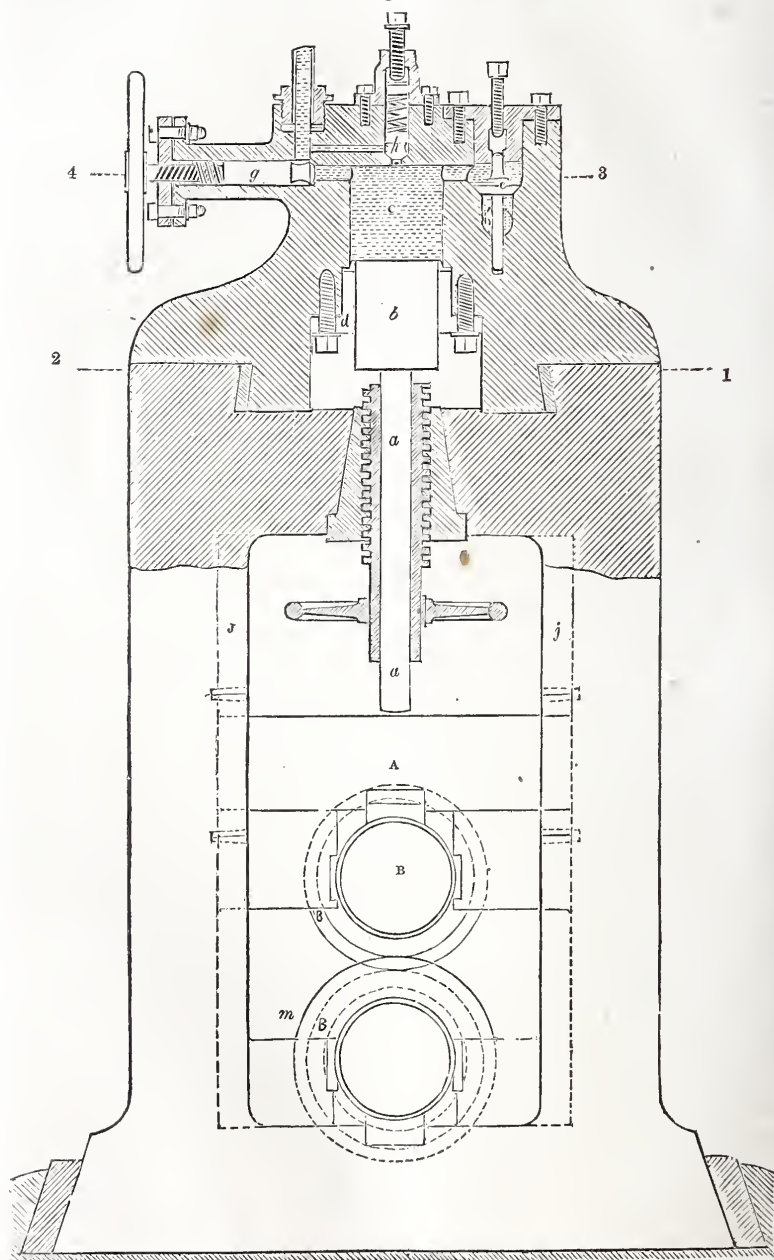


Fig. 3.

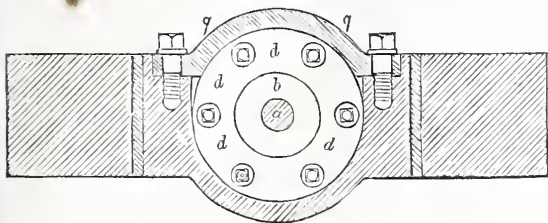


Fig. 4.

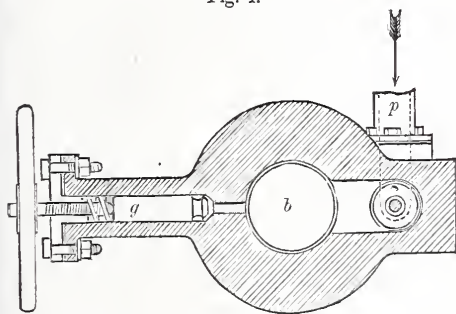


Fig. 5.

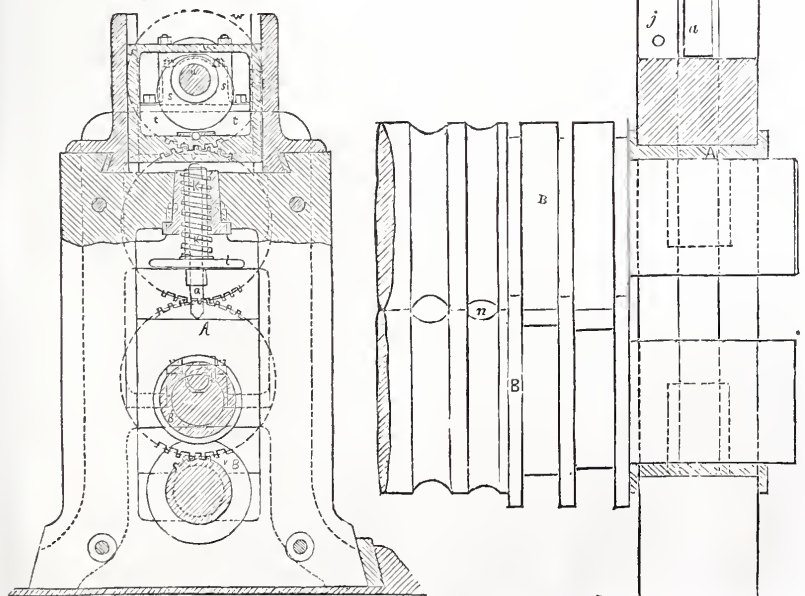
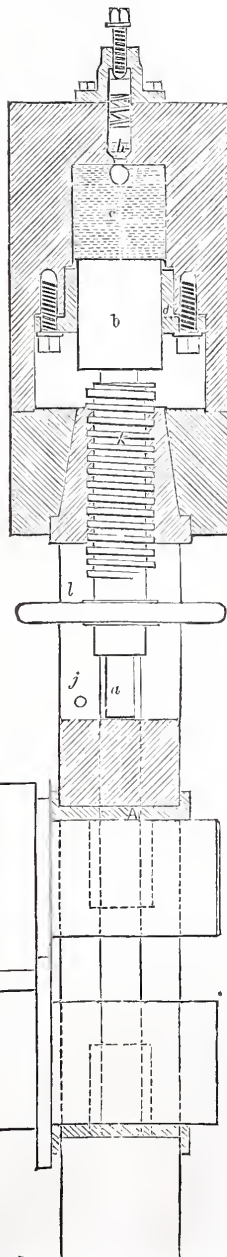


Fig. 2.



tion taken in the line 1, 2, of Fig. 1, showing the parts inverted, or as seen from below, and Fig. 4, is another horizontal section taken on the upper side in the line 3, 4, of Fig. 1, showing the entrance and exit valves of the chamber of water, and the means of working or regulating the exit valve. In the rolling mills usually employed for rolling bar iron, the rollers are generally mounted in fixed bearings, or bearings which, during the operation of rolling are rendered immovable, by being maintained in their places by strong screws or bolts.

In my improved machinery, or apparatus, the ends of the bearing *A*, of the upper roller, are let into grooves in the standards, as in ordinary rolling mills, in such a manner as to admit of their sliding up and down therein, in order that by so sliding, the parallel distances between the rollers may be allowed to change.

The rising of the bearings with the upper roller, is regulated and governed by piston rod *a*, which rest on the top of the bearings, the upper end of the piston rod being connected to the solid piston *b*, of the hydraulic cylinder, or water chamber *c*, as shown in figures 1 and 2.

This cylinder *c*, is filled with water, or other non-elastic fluid or liquid, and is furnished with leather or other suitable packing for the purpose of preventing any leakage of the water.

The packing is kept in its place by a metallic ring or plate *d*, which is firmly secured to the body of the cylinder by strong screw bolts.

The cylinder is supplied with water from any convenient source, by a lateral tube *p*, shown in Fig. 4, through the rising feed valve *e*, the construction and operation of which will be clearly understood by referring to the drawing.

f, is the exit valve, through which, when partially opened, the water is allowed to escape from chamber *c*, on pressure being applied to the lower end of the rod *a*, by which pressure the piston *b* will be made to rise and partially to expel the water, as will be the case when a bar of iron is passed between the shaping rollers *B* & *B*. The valve *f*, is constructed in such a manner that the opening for the discharge of the water may be regulated with the greatest exactness by merely advancing or receding the plug *g*, worked by the screw at its back end, the effect

of which will be to open or close the valve to any extent that may be required.

There is a slight spring behind the plug *g*, which is merely intended to push it forward and close the aperture of the valve when the upward pressure of the piston is not in action, as will be the case when the rolling operation is suspended. An additional valve *h*, is also made to communicate with the exit passage *i*. This valve, however, is always kept closed by a strong spring, as shown, and will never allow any water to escape this way from the cylinder, except when any extraordinary pressure takes place, at which time the power of the spring will be overcome, and by yielding, prevent the machinery from being too greatly strained.

In introducing into my improved machinery a mass of iron between the shaping rollers, say for the purpose of producing a wedge-formed bar, having parallel edges, I employ a pair of rollers of the ordinary kind having the grooves and flanges, as shown in Figure 2.

The mass of iron being about to be introduced between the rollers in the first groove, I open the valve *f*, by withdrawing the screw behind the plug *g* to such an extent as will allow the escape of water from the chamber *c* in a small current, regulating the opening for the intended discharge according to the required taper of the bar to be formed, the required extent of which opening will readily be found by the experience of the workman. The operation of rolling now proceeding, the pressure of the metal passing between the rollers, will cause the bearings of the upper roller to rise and force up the piston rod *a*, in doing which the piston will be made to rise in the chamber *c*. But the ascent of the piston being resisted by the non-elastic fluid in the chamber *c*, the escape of water through the valve *f* and outlet *i* must take place to allow of the ascent of the piston, and consequently the separation of the rollers; according, therefore, to the rate of the escape of water will the taper or inclined shape of the bar to be produced, be determined.

It will thus be seen that, by my improved apparatus, the process of rolling metals is carried on much in the usual manner, except that by means of opening the

valve more or less, the escape of the water from the chamber will allow the upper roller to rise, and consequently give the requisite taper form to the bar under operation, according to the rapidity with which the water is allowed to flow out of the chamber. As I do not intend to confine myself to any particular forms of bars to be produced by my improved machinery, it is not necessary to describe more precisely the shapes of the rollers. I will therefore only add, that by forming the grooves of the rollers in elliptical shapes, as at *n, n*, in fig. 2, I am enabled by the gradual rise of one of the rollers, and repetitions of the rolling operation, to produce bars of conical figures.

It is sometimes desirable to roll a bar taper or wedge-formed, for a portion of its length, and level for the remainder of its length.

For this purpose it will be necessary to allow the upper roller to rise to a certain distance only, and then to stop. This I effect by means of adjusting-screws *k, k*, one over each bearing of the rollers, similar to those heretofore used, except that it is through the axes of the adjusting-screws, forming guides, that the piston rods *a* pass, as shown in the drawing at Fig. 1, and it will therefore be understood, that when, by the escape of the water from the chamber, the bearings of the rollers have been allowed to force up the piston rod and the piston a certain determined distance, that then the upper edge of the bearing *A* of the top roller will come into contact with the underside of the adjusting screw *k*, beyond which it cannot rise, and as the bearings will, for a time, become fixed, the bar of iron under operation will, for the remaining portion of the process, be rolled parallel.

The adjusting screw *k* passes through a hollow screw made in a socket fixed in the frame, and the screw can easily be raised or lowered, so as to limit the rise of the bearing *A*, by merely turning the hand-wheel *l*, attached to its lower part.

It may be as well to observe, that the standards or housings may be of any convenient known pattern, and that a lever or other known balance may be used with advantage to support the roller in its rise and fall. A portion, also, of the head of the standard in which the piston works is made removable for the

purpose of getting at the piston, and packing when required, as will be seen at *q, q*, in figures 2 and 3.

MACHINE FOR PLANING, TONGUING, AND GROOVING LUMBER.

Patented by R. & C. S. Bixby of Ohio, May 15, 1831.

Fig. 1 is a plan. Fig. 2 is a longitudinal vertical section taken at or near the centre. Fig. 3 is a view of the thickening planes. Fig. 4 is an edge view of the grooving cutters and clearing chain. Fig. 5 is a back view of one of the cutters, shaving also the clearing chain in section. Similar letters of reference indicate corresponding parts in each of the several figures. *Our invention relates to that form of planing machinery in which stationary planes and tonguing and grooving cutters are employed. It consists, first, in an improvement in the form and arrangement of the thickening planes; and, second, in the employment of an endless chain or band working in a recess in one or both sides of the grooving cutters, to prevent the recesses at the back of the cutting edges being choked or clogged by the shavings or dust produced in cutting the groove in the stuff.*

To enable others skilled in the art to make and use our invention, we will proceed to describe its construction and operation. *A* represents the framing on which the machinery is supported. *B B* are two pairs of feeding rollers, and *B' B'* other pairs of feeding rollers for carrying forward the stuff to the planes; these rollers are all driven by toothed wheels on their shafts, which receive motion through a toothed pinion on the main or driving shaft *E*, which is driven by a drum *F*. *c c* are a set of straight-edged planes, secured permanently, so as to plane the underside of the board smooth. *D D* are the thickening planes, which are narrow planes, having a rounded or gouge-shaped edge (see Fig. 3); they are arranged close together in rows or series, in an iron frame *G*, the said rows or series being placed one behind another, and the planes in each row so arranged, that the planes of no two rows shall be exactly opposite each other, but that the face of the board shall be equally divided by the most prominent points of the cutting edges of the planes. In the same

Fig. 1.

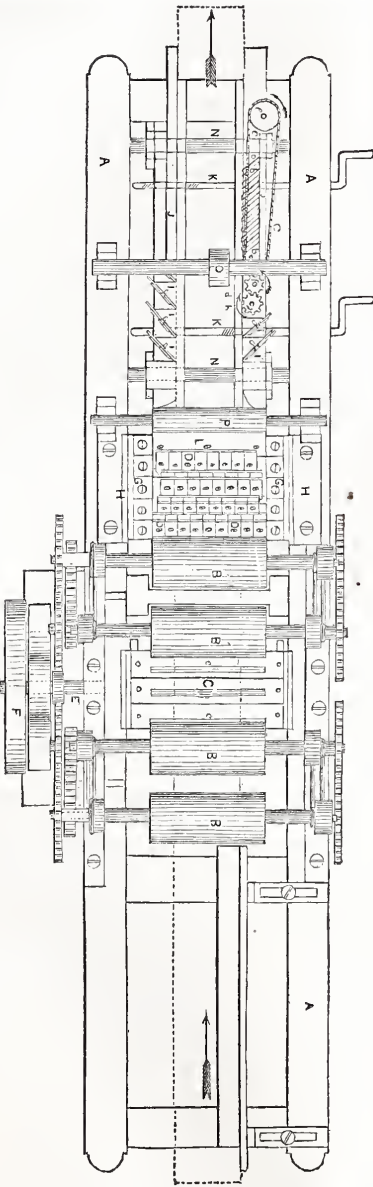
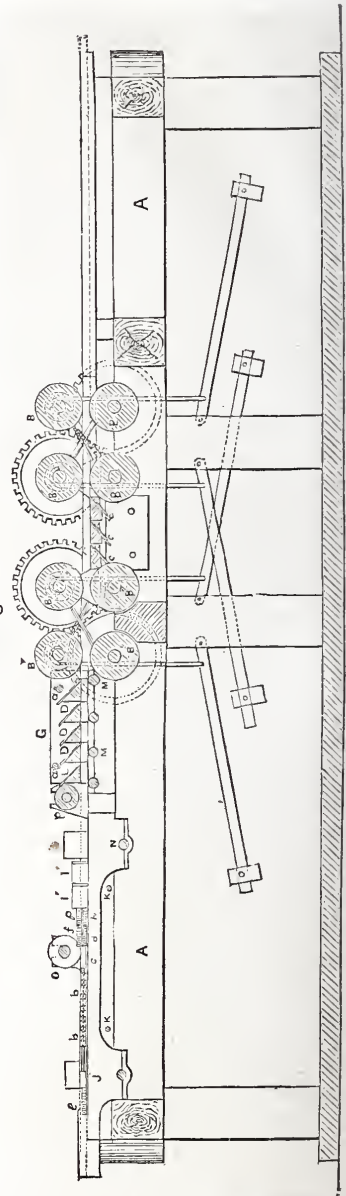


Fig. 2.



frame G, behind the planes D D, are one or more straight-edged planes, L, extending all across; these are for finishing.

The frame G is adjustable at any height for the purpose of reducing the board to any required thickness, being secured by

screw bolts A A, passing through vertical slots to carriages H H on the sides of the frame. Below it are a series of small rollers M M, which form part of the bed on which the board runs. I I are planes for reducing the board to its required width and planing the edges smooth;

Fig. 3.

Fig. 5.

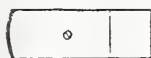
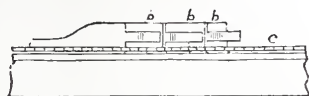


Fig. 4.



they are secured upon carriages J J, which are supported upon bars N N, on which they slide, and are adjustable at any required distance apart by means of screws K K'. The carriage J carries the tonguing cutters, and J' carries the grooving cutters b b, which may be of any known form and construction. c is an endless chain running on two pulleys, d and e, which turn freely on fixed vertical spindles or pins on the top of the carriage J. One side of this chain works in a recess in the shoulders, against which the edge of the board runs below and behind the grooving cutters, while the groove is being cut, and is parallel and nearly flush with the said shoulder, but must not project beyond it. Secured to the pulley d is a toothed wheel f, which gears into another wheel g, to which is secured a small roller h, both the wheel and the roller turning freely on a spindle or pin secured on the carriage J'. The edge or periphery of the roller h, stands just even with the edge of the board being operated upon, and will be set in motion by the contact of the board as it passes it. p and o are pressure rollers for holding down that part of the board whereon the edges are being planed, tongued, and grooved. The board is represented in figures 1 and 2 by dotted lines.

The operation of the machinery is as follows:

Rotary motion is given to the main shaft E, and communicated to the feed rollers. The board is fed in at the end

of the bed to the left of the drawing, and as the feed rollers B B draw it forward, the planes c c smooth the lower side, the rollers B' B' then bring it to the planes D D, which take off the shavings in narrow strips, and reduce it just so much that the smoothing plane or planes L, will finish it to the proper thickness. The planes D will be found to operate more effectually than the *straight-edged* planes now in use, especially in knotty stuff, as only a small cutting surface will act upon a knot at the same moment, therefore the machine is not so likely to be brought to a stop; they will also clear themselves better in cutting.

From the thickening planes the board is carried to the planes I I and I' and reduced to the proper width; it then goes on to the tonguing and grooving cutters, which operate in the usual manner. One disadvantage which has been found to exist in the employment of stationary grooving cutters cutting sidewise, was that the dust and fine shavings collected under the cutters between the shoulders of the cutters or cutter blocks, and the edge of the board; this disadvantage we design to remedy by the employment of the chain c, which receives motion through the edge of the plank which comes in contact with, and gives rotary motion to the roller h and wheel g; this giving motion to f, moves the pulley d and the chain c, the direction of whose motion is shown by an arrow 2; this chain loosens any dust or shavings which may collect, and the board itself removes them as it travels along. The same effect may be produced, though not so effectually, by a cord or band.

IMPROVEMENTS IN MINE MACHINERY.

WHITE AND GRANT'S SAFETY CAGE AND
DISENGAGING CATCH FOR MINE SHAFTS.

From the Glasgow Practical Mechanic's Journal.

The newspapers are constantly reminding us of the many imperfections of the mechanical details of the miner's machinery—in their records of accidents from the "failure of the rope," and "overwinding"—casualties, which might be completely driven out of existence by a proper attention to the construction and management of the lifting apparatus. A rope breaks, or a cage is over-wound—one or two men are killed—their widows

examination into the existing arrangements of the machinery, and to provide a means of remedying the apparent defects. The invention is put in practice, is found too heavy and complicated, gets out of order, and perhaps fails in a case of actual fracture: the colliery owner grows apathetic, the apparatus is thrown aside, and the old system is again pursued.

We have delineated four several points of improvement introduced by these gentlemen, three of which are devoted to the prevention of rope accidents alone. Fig. 1, represents a side elevation of a cage, or lifting apparatus, with its overhead winding pulley, platform and slides, as fitted with the new safety apparatus. Fig. 2, is a corresponding front view of the same. A, is the cage built or constructed in the usual manner and fitted with slides, B, for the vertical timber guides, c, by which the cage is accurately guided vertically in its ascent and descent. The links, D, connected at their lower ends to the top of the cage, converge upwards, to an eye, at E, which is passed upon the lower end of the vertical link-piece, F, and in this way the cage is suspended from the latter, by the collar at the end. The link-piece, F, is again connected by a link at G, to the chain, H, which is represented in the engraving as broken, in order to economize space, and the upper end of this chain is again linked to the junction plate, I, of the flat winding rope, J, passing over the head winding pulley, K, to the winding power. An eye, L, is formed on the extremity of the link-piece, F, to carry the ends of the two safety chains, M, which form the connection between the rope or suspending apparatus, and the stop or safety apparatus, carried on the top of the cage. At N, are two metal brackets bolted to the cross pieces on the top of the cage, one on each side, opposite, and corresponding to each other. Each of these brackets has two solid eye bearings, O, to carry the ends of the horizontal parallel shafts P, each of which has keyed upon it at its longitudinal centre a grooved chain or rope pulley, Q. The lower end of the two safety chains, M, pass partially round these pulleys, and are connected to the peripheries of the latter, by transverse pins, at R, passed through the rims. Near these pins two other similar pins, S, are similarly attach-

ed to the peripheries of the pulleys, and a single ring or endless band of vulcanized India-rubber, is passed upon these pins, so that when the pulleys are turned outwards in the direction of the arrows, the ring being extended beneath the pulleys from pin to pin, the strain causes it to assume the form of a duplex band, as at T. Or, instead of this ring, a single band may be used, an eye being formed on each end of it, for attaching it to the two pins. The shafts, P, extend beyond their bearing brackets, N, sufficiently far to receive the eccentric clipping, or stay pulleys, U. There are four of these pulleys, one being on each end of each shaft, one of the cage guides, C, coming between each pair. Each pulley is serrated or toothed on a portion of its periphery, as at V, in figure 1, in order that when turned inwards, in the direction of the arrows marked upon them, so as to bring their eccentric portions towards the guides, the serrations, at V, may bear on each side of the guides, and afford a hold to stay the descent of the cage. As delineated in the plate, the cage is supposed to be in action, and has just arrived above the platform of the shaft, or is about to descend below it. The winding rope and connections throughout, are further supposed to be in proper working order, and the tension upon these parts is consequently acting so as to retain the safety apparatus out of connection with the guides. The link, F, which supports the cage, is inserted loosely into the eye, E, in such manner, that it may, when necessary, slide through the latter from *a* to *b*. By this arrangement, when the tension occasioned by the weight of the cage comes upon the winding rope, the latter, first of all, hauls up the safety chains, M, which thus turn the pulleys Q, partially round, as indicated by the arrows. This action extends the elastic band spring, T, and eases off the two eccentric pulleys, U, so as to free them from contact with the cage guides. When this is accomplished, the collar at the lower end of the link, F, comes in contact with the under side of the eye, E, and bears up the cage. In this way, so long as the rope and suspending connections remain whole, the resulting tension upon the safety chains keeps the stop apparatus clear of the guides, and allows the cage to move freely up and down;

but should the rope or links break, the reacting elasticity of the spring, *t*, will turn round the shafts, *r*, in the direction of the arrows on the pulleys *u*, in figure 1, when the serrated portions of the peripheries of these pulleys will come in contact with the opposite surfaces of the guides, *c*. The grasp thus occasioned upon the guides, holds up the cage until the rope is re-adjusted, when the upward tension of the latter will again put the safety apparatus out of gear. It is to be observed that the action of the pulleys, *u*, is such, that the greater the weight upon the cage, the more secure will be the hold of the pulleys upon the guides, as the downward pressure causes the serrations to bear inwards upon the guides.

In fig. 2 is represented a second arrangement of a spring apparatus for actuating the clipping or holding pulleys of the cage, and the same movement is also delineated on a larger scale in fig. 3, where one lever only is shown, detached. A central cross-bar, *w*, has fastened to it, near each end, a cast-iron box, *x*, containing layers of vulcanized India-rubber, *y*, to act as a spring, or instead of India-rubber, any other suitable elastic material may be used. Each box has an eye-piece, *z*, formed upon it to receive the eyes on the outer ends of the spring levers, *c*, the opposite ends of which are linked at *d*, to the chains, *e*, one end of each of which passes round one of the pulleys, *q*, the shafts of which are, in the detail, fig. 3, supposed to be broken away. Each lever, *c*, has formed upon it a projecting piece, *f*, to fit into the narrow open-topped boxes, *y*, and press upon the surface of the contained spring, and thus the reaction of these springs constantly tends to elevate the levers, drawing up the chain, *e*, and partially turning the pulleys, *q*. The shafts of these pulleys carry eccentric clipping pulleys, as already described in reference to figs. 1 and 2, so that this upward action of the levers tends to cause the pulleys to bite upon the guides and sustain the cage when the tension of the safety chains, *m*, which are also attached to the pulleys, *q*, no longer opposes the springs, on the fracture of the rope.

Another modification of these improvements in the machinery or apparatus to be used for the prevention of accidents from the breaking of the winding-rope,

and also applicable for the prevention of what is technically known as "over-winding," that is, the elevation of the cage or lift apparatus so high up as to come in contact with the overhead gear, and occasion serious accidents to life and property, is also to be described in reference to figs. 1 and 2. The overhead winding pulley, *k*, is carried on a shaft resting in movable or sliding brasses, *g*, which have liberty to move vertically up or down in the slotted heads, *h*, of the bearing pedestals, *k*. The bottom of each of these slotted guides is filled in with layers of some elastic material, as India-rubber; which material is retained in position by the external flanges, *l*, of the sliding brasses, shown as broken away in fig. 1, in order to exhibit the elastic material behind. The shaft of the winding pulley projects slightly on one side, at *m*, and to this projection an eye of a short link-rod, *n*, is loosely jointed. The lower end of this link is connected at *o* to the short end of the lever, *p*, working loose on a fixed stud-centre in the top of the pillar or standard, *q*. The opposite end, *r*, of this lever is connected to two short chains, *s*, the contrary ends of which are fast to transverse pins, *t*, in the peripheries of the small pulleys, *u*. These pulleys, *u*, are keyed on the short horizontal shafts, *v*, supported in the bearings, *w*, on the timber frame, *x*, carrying the overhead gear. Alongside each of the chain pulleys, *v*, a second pulley, *y*, is fastened upon the shafts, *v*. In each of these pulleys, *u*, a pin, *z*, is fastened, to receive the opposite ends of an elastic band, *1*, passing across from one pulley to the other on the upper side. Each of the shafts also has fast upon it a serrated eccentric clipping pulley, *2*, formed like the pulleys, *u*, already described. The winding rope, *j*, passes between these clipping pulleys, and the elastic tension of the band, *1*, has a constant tendency to cause them to nip and sustain the rope between them. During the action of winding, the tension of the winding rope in passing over the pulley, *k*, causes the shaft of the latter to press upon the elastic material in the slotted guides, *h*, of the bearing pedestals, through the sliding brasses, *g*, which thus descends as the weight comes on the pulley, until the bottom of the flanges, *l*, rests upon the projections, *3*, which thus support the weight of the

load. This descent of the shaft, acting through the link, *n*, elevates the end, *r*, of the lever, and draws up the two chains, *s*, turning the shafts, *v*, outwards in the direction of the arrows, so as to ease off the pulleys, 2, from contact with the rope.

Should the rope fail, so as to relieve the winding pulley, *k*, from the downward pressure, the reaction of the elastic material beneath the pulley shaft will cause the shaft and pulley to reascend, drawing up the link, *n*, which thus allows the chains, *s*, to slacken, when the elastic band, 1, reverses the pulleys, 2, causing them to nip the winding rope and sustain the cage. This latter arrangement of a safety apparatus is obviously applicable for the prevention of the accidental falling of the cage, only when the failure of the rope takes place at or above the line of the shafts, *v*; but in cases of "overwinding," it answers the same purpose as the previously described plan, in preventing the cage from falling when the latter is detached from the winding rope by the action of the disengaging catch.

This movement is delineated in fig. 2, and it is also shown detached, with the hook open, in fig. 4. The link, *r*, in place of being directly connected to the suspending chain, *h*, is attached, through the medium of the catch, 4, which turns on a stud centre at 5, fast in the link, *r*. The upper portion of this catch is formed with a species of flat hook at 6, which enters a slot in the link, *r*, passing through the loose link, 7, on the stud of the lowest link, *g*, of the chain, *h*. The pull of the rope thus comes upon the hook, 6, which is kept from accidental disengagement by a slight wooden pin, 8, passed through the link, and through a hole in the end of the hook. As an additional holder, a blade-spring, 9, is attached to the side of the link, *r*, and presses upon a projecting tail, 10, of the catch. If at any time the cage should be overwound, the tail, 11, of the disengaging catch comes in contact with a stop-piece, 12, set at the proper height to come into action before the cage arrives at the winding pulley. When this occurs, the pressure of the stop on the tail, 11, turns the catch on its centre, 5, breaking out the wooden pin, 8, and releases the link, 7, from the hook, 6; each or

either of the stop actions for holding the cage then comes into action as already described, and the cage remains suspended, whilst the rope and chain may pass over the winding pulley without causing any damage.

Another branch of improvement refers to the discharging platforms of mine shafts. These are also delineated in figs. 1 and 2. The inclined stages or platforms, 13, for the conveyance of the wagons to and from the cage, are jointed at 14, to the edges of the discharging platform or stage, 15. The lower surface of this platform has upon it four projections or pistons, 16, which are fitted to work vertically in cylinders, 17, on the bottom-plate, 18. Each of these cylinders has in it a series of layers of India-rubber, so that when the wagons or corves are run on or off the platform, they afford an elastic support to receive the weight; the vertical movement of the platform, 15, being allowed for by the joints, 14, and the inclined stages, 13, having liberty to slide at 19. It is evident that this arrangement of elastic supports is applicable to various other similar purposes, where it is an object to mitigate the effects of concussion.

Lastly, it is proposed to make the trap-doors, in the workings of mines, completely automatic, so as to dispense with the employment of trappers. Instead of employing a boy to attend to the opening and closing of the trap-doors as the miners pass through, Messrs. White & Grant's arrangement provides that the passage of the miners shall effect the opening and closing by a self-acting apparatus. A weight is hung to a cord, passing over a vertical pulley, supported by a bracket in the line of the plane of the door when closed. From this pulley the cord passes between two horizontal pulleys to the top edge of the door where it is attached. On each side of the door a curved spring, of flat metal, is fitted with slots at each end, to slide upon fixed studs in the door; so that when the miners' corves or wagons are pushed up against the closed door, they will come in contact with one or other of the springs, and through them, push open the door, without much concussion. When the wagon has passed through, the weight, in falling, acts over the pul-

leys, and draws the door again to its central closed position. In this way the constant personal attendance of a boy at the door is dispensed with, as the opening may be effected in each direction by the object passing through, whilst the closing is always effected with certainty by the descent of the weight. It is obvious that this arrangement may be applied to all the doors in a mine which it is necessary to keep carefully closed, except at the moment of the passage of the men through them.

This arrangement of self-acting trap-doors is now being introduced into some extensive collieries in the neighborhood of Glasgow. The adoption of the plan will effect very considerable economy, besides doing away with a branch of employment which is essentially inhuman and degrading.

MINOT ROCK LIGHTHOUSE.

Having first called attention in our February number to the Minot Rock Lighthouse (before its destruction in the late gale), and having still undiminished confidence in the principle of the structure for exposed positions, we present our readers with the following Official Report of the Constructing Engineer, to the Bureau at Washington, accompanied by an illustration of the appearance of the iron piles after the destruction of the building:—

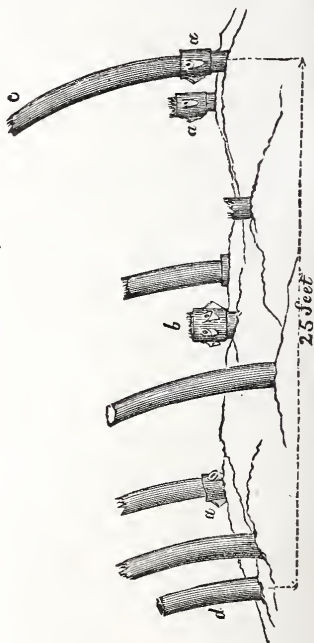
Boston, April 30, 1851.

SIR:—In the brief note which I had the honor to address you on the 17th instant, informing you of the destruction of the Minot Rock lighthouse, I stated that I would make a report to the bureau of the facts as soon as I could collect the necessary information. I am now in possession, I believe, of all the circumstances that are known, and proceed to enumerate them.

On Monday night, the 14th instant, the wind, which had been easterly for several days, gradually increased. On Tuesday it had become a severe gale from the N. E. It continued to blow with the utmost violence through Tuesday night, Wednesday, Thursday, and even Friday, but the height of the storm was on Wed-

nesday, the 16th, and at that time it was a perfect hurricane. It was, in fact, unprecedented; for, notwithstanding the great gale of September, 1815, was well remembered here, it was from the S. E., and was of short duration.

The light on the Minot was last seen from Cohasset, on Wednesday night, at 10 o'clock; at 1 o'clock Thursday morning, the 17th, the lighthouse bell was heard on shore, one and a half miles distant; and this being the hour of high water, or rather the turn of the tide, when from the opposition between the wind and the tide—the former blowing on shore, and the latter receding from the shore—it is supposed that the sea was at its very highest mark; and it was at that hour, it is generally believed, that the lighthouse was destroyed; at daylight nothing of it was visible from the shore, and hence it is most probable it was overthrown at or about the hour named.



The two assistant keepers, Joseph Wilson and Joseph Antonio, were lost; the principal keeper, John Bennett, had left the lighthouse on Friday, the 11th

inst., and of course escaped the fate of his companions. The light, as I am informed, was left by the keeper without a boat; and thus the means of escape were entirely cut off. I cannot say that the boat could have lived in such a sea; but, inasmuch as it was provided for that purpose above all others, it is certain that the course of the keeper, in leaving the men in the light without a boat, was entirely inexcusable, and even criminal.

The general construction of the Minot light is now tolerably well known; but, in order that the remarks which I shall make may be understood, I find it necessary to enter upon some details.

The structure was composed of 9 piles or shafts, made of the best description of wrought-iron, from 60 to 63 feet in length, each pile inserted 5 feet deep in the solid part of the rock; all of them were 8 inches in diameter at the foot, 10 inches in diameter at a point 5 feet above the foot (at the surface of the rock); the middle pile was 6 inches diameter at top, and the outer piles were $4\frac{1}{2}$ inches diameter at top. These piles stood in the periphery of a circle of 25 feet diameter, with one at the centre. They were united or connected together at five different points, to wit: At the rock, where each pile was secured in its place, by means of iron wedges, and a cement of iron filings. 2d. At a point 20 feet above the rock, by means of 16 wrought-iron horizontal braces, $3\frac{1}{2}$ inches diameter radiating from the middle pile to each outer pile, and extending, also, between each pair of outer piles. 3d. By a similar series of braces at a point 40 feet above the rock, of round wrought-iron, 3 inches in diameter. 4th. At a point 47 feet above the rock, by a series of the same kind of braces of wrought-iron, $2\frac{1}{2}$ inches square, forming the support of the store-room or cellar. 5th. By means of a cast-iron cap or spider frame, 14 feet in diameter, and weighing about 5 tons, to which was united and secured all the pile-heads; this frame formed the base or support of the keeper's house or living room, 8 feet high. Upon this, again, was placed the lantern of iron and glass, of about six feet in height; thus was the entire elevation of the structure above the rock about 70 feet, standing upon a base of 25 feet, and upon all the available surface which the rock presented at low water.

In addition to the horizontal braces, there was introduced, in the summer of 1849, a series of wrought-iron vertical tie rods between the first and second series of braces; these ties, 32 in number, of $1\frac{1}{2}$ inch round iron, extended between each pair of contiguous piles and between the middle pile and each outer pile, crossing each other in a diagonal direction, like the brace and counter-brace of a bridge. The object of these ties was to stiffen the piles, and to prevent, in as great a degree as practicable, the tendency to vibration, which there necessarily would be at the top of piles 60 feet high, howsoever well braced they may be.

It was intended to place another series of these ties, arranged in the same manner, between the foot of the piles at the rock and the first or lower series of horizontal braces, but the appropriation for that purpose not having been made until October, 1850, the season was too far advanced to get them in place; the collars and six of the ties used were placed; and it was these lower unfinished ties which were carried away in the storm of December, 1850—not the braces; these were not injured.

From the preceding description, it will be seen that there was a series of braces 40 feet above the rock; upon these braces the keeper had improperly built a sort of deck or platform upon which was placed a quantity of heavy articles, such as fuel, water-barrels, &c., all of which should have been in the store-room; the place designed for their reception. The deck, in addition to the weight placed upon it, was fastened together and secured to the piles and braces—thus offering a large surface for the sea to strike against.

In addition to this, the keeper had attached a $5\frac{1}{2}$ -inch hawser or guy to the lantern deck, 63 feet above the rock, and anchored the other end of the hawser to a granite block, weighing, according to his own account, 7 tons, placed upon the bottom, at a distance of some 50 fathoms from the base of the light. The object of this was to provide means for running a box or landing-chair up and down; but it is very clear that so much surface exposed to the moving sea had the same effect upon the lighthouse as would have been produced by a number of men pulling at a rope attached to the highest

part of the structure with the *design* of pulling it down.*

How much these two ill-judged arrangements contributed to the destruction of the lighthouse I will not undertake to say; but that both were highly injurious there can be no doubt. The inclosed newspaper communication, from a man who had an active part to perform at the Minot for the contractor who drilled the holes in the rock, and who crected the piles in place, will serve to show the view taken of it by a sound, practical mind.

With these details premised, I proceed to state the information I have collected and the conclusions to which I have arrived.

On the 18th instant, I desired my former assistant in the work, Mr. William Dennison, to visit the rock, examine its appearance, and collect such facts as might fall within his reach. It was not until the 22d instant, however, that the sea or swell had abated sufficiently to enable him to see clearly the precise condition of the foundation. Even then the roll of the sea prevented a landing upon the rock; but by the aid of a very experienced boatman, the boat was kept within 10 feet of the rock; and, by going around it several times, he was enabled to make the inclosed sketch, which represents the present appearance of the piles.

It will be seen that the foot of every pile is in its place; and the accompanying report of Mr. Dennison says: "I could not see the slightest change in the rock whatever; the piles appeared to be wedged as firm in the rock as ever. I could see the heads of the wedges slightly projecting from the surface of the rock, in the same position as when left by me in November, 1849."

This is a sufficient refutation of the often repeated story of the "split rock"—this, like other statements from the same source, being entirely untrue. A "spall," as it is called technically, was knocked off one of the holes in drilling the rock in 1848, of no sort of importance, because the hole was carried sufficiently deep below it.

The foundation of the structure then being precisely as it was left in 1849, and

the feet of the piles being now in place, it is clear that there was nothing there which yielded. We are to look elsewhere, therefore, for the cause of the destruction of the lighthouse; and this we have the means of stating, I think, without question.

At four o'clock on Wednesday afternoon, the 16th, or 10 hours before the light fell, the deck or platform, which the keeper had placed on the second series of braces 40 feet above the rock, came ashore at Cohasset. Now, as this was entirely too bulky and too heavy for the assistant keepers to move, it is plain that the sea must have reached it and uplifted it from its place; the men were incapable of doing it. This deck, being 40 feet above the rock, was 43 feet above the line of low water, and 28 ft. above high water, spring-tides, according to the tide tables furnished by the coast survey. (See my report to the bureau of 1847-'48.) In other words, the sea had at that time reached within seven feet of the base of the store-room of the lighthouse. Without undertaking to speculate upon the probable shock that the structure must have received from the effect of the sea upon a platform fastened to the piles 40 feet above the rock, it is enough to know that, say at 2 o'clock in the afternoon, the sea had reached within seven feet of the body or solid part of the structure. The sea was still increasing (the effect of the continued gale), the night tide was full at about midnight; and it required but a slight increase in the height of the wave or sea, after having reached the deck in the second tier of braces, to bring it in contact with the main body of the structure. When this took place it is plain to perceive that such a sea, acting upon the surface of the building, at the end of a lever 50 or 60 feet long, must be wellnigh irresistible; and I doubt not that the lighthouse was thus destroyed.

The conclusions which I arrive at, therefore, are these:

First. That the sea did reach the main body of the structure.

Second. That the platform, or deck, placed by the keeper on the second series of braces, contrary to the design of the builder of the lighthouse, contributed to the overthrow.

Third. That the guy, or 5½-inch hawser, attached by the keeper to the top of the

* Since writing the above, it has been ascertained that the rock, to which the guy was attached, was washed in shore 400 to 500 feet.

lighthouse, and extending 300 feet north-west, or in a direction directly at right angles to the direction of the sea, north-east, had a most injurious tendency, and that it was enough, in itself, to cause the overthrow of the lighthouse, had the sea not reached the body of the structure. It is easy to perceive that the force of such a sea upon 300 feet of a hempen rope of $5\frac{1}{2}$ inches must have been immense, when that rope was attached to the weakest part of the building, that is the lantern deck, 60 feet above the rock.

Since the destruction of the Minot, the question has been several times asked, was the structure built upon correct principles; and can such a lighthouse be made to stand there? The answer, in my opinion, is this: The base of a stone structure at that exposed situation should be not less than has been adopted for the principal towers on the coast of Great Britain. The Bell Rock, Carlingford, Skerryvore, and Menai, have a base of 40 feet, the least, to 48, the greatest; the Eddystone rock is about 50 feet at low-water line, and the diameter of the tower at high-water line, 16 feet above, is 26 feet.

At the Minot, a circle of even 26 feet diameter at low water cannot be had. There is not, in fact, as much space to be had at low water as the diameter of the tower should have at high water; while between the two tides there is a height of 16 feet to be provided for.

Without any reference to the cost of a stone structure, I venture the opinion, after the experience had there, that no tower can be made to stand, even if constructed upon the principle of the Eddystone; for it is to be remembered that while the Eddystone rock is bare at high water, spring tides, the Minot is barely uncovered to the diameter of 25 feet at low water, spring tides. During the first season's operations there (1847), from July to October, three months, sixty hours was all the time that the men could work upon the rock, and this under the eye of a most vigilant and energetic contractor employed to drill the holes in the rock.

A structure similar in its general characteristics to the iron pile light is alone suited to the locality; that is to say, a structure which offers the least resistance to the force of the wave.

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The experiments of Mr. Stevenson at the Skerryvore have established that the maximum force of the sea in a gale of wind, as determined by a dynamometer, is about 6,000 pounds per square foot, or about 42 pounds per square inch—a pressure nearly double that exerted upon the piston of an ordinary condensing steam-engine. A base of larger area than that afforded at the Minot is requisite to resist such pressures as these. The sea must be allowed a free passage, or there must be sufficient weight in the tower to countervail the effect of the wave. To provide the necessary amount of weight requires a base of large area, unless the tower be carried to an undue height.

By suppressing the store-room, an additional space of 8 feet could be had for the passage of the sea in a gale of the unprecedented violence of that which we have just passed through; but I conceive that no greater height could safely be given to the lighthouse than that adopted for the structure which was put up there, say 55 feet for the top of the piles above the rock, the base being limited to 25 feet; a greater height is not admissible. Had the space admitted, I should certainly have used it to the extent of 35 or 40 feet. The structure had been up three winters, and but for this unprecedented gale would still be up, as I believe. The principle of the iron pile light requires the solid part of the building to be kept above the reach of the sea. So long as this was the case, the Minot resisted the storms, and there were several of great violence within its time; but, when the sea did reach the keeper's house, it of course destroyed the entire fabric.

Finally. The Minot light had all the base that the rock afforded; it had all the height that could safely be given to such a base. Spring tides rise there about 15 feet, according to the observations made by the coast survey; this left a space between the top of high water and the bottom of the store-room of 35 feet for the unobstructed passage of the sea; notwithstanding this the sea did reach above this line, and the result is too well known.

I inclose herewith the report of Mr. Denison—a sketch representing the present appearance of the stumps of the 9 piles, varying in length from 6 inches to 10

feet—and the newspaper article which I have referred to in the body of this report.

I have the honor to be,

Your obedient serv't,

W. H. SWIFT, Agent for U. S.

Colonel J. J. ABERT, Chief Topographical Engineers,
Washington.

—
BOSTON, April 22, 1851.

DEAR SIR:—Agreeable to your request I have this day visited the remains of Minot's Rock light, to make an inspection of the same.

I found that all the piles had broken off between the rock and first series of horizontal stays. Pile No. 1 (the north-west pile) was broken about 6 inches from the rock. No. 2 (the next to the eastward) was broken about 10 feet from the rock. No. 3 and 9 (the centre pile) were broken just even with the top of the lower hubs, or about 2 feet from the rock. The remaining piles were broken off from 3 to 6 feet from the rock. The piles, or stumps of piles as they now stand, all curve to the southwest, as the accompanying sketch will show.

The sea being a little rough I was unable to land: but it being low water, and having a good boatman, (Mr. Elijah Pratt,) I was enabled to approach near enough to have a good view of the whole surface of the rock. I could not see the slightest change in the rock whatever; the piles appeared to be wedged as firm in the rock as ever. I could see the heads of the wedges slightly projecting from the surface of the rock, in the same position as when left by me in November, 1849. The structure when carried away fell to the southwest—that is, directly towards the inner Minot. I could see the second series of horizontal stays projecting about four or five feet out of water, laying about 125 feet from the rock. They did not appear to be much broken or deranged from their structure; but three of the uppermost piles, as they lay, had been broken off about 3 feet below these stays; therefore, these piles have been broken into three pieces. I was unable to learn whether the other six piles were broken off in the same manner or not, they being under water, and the sea being too rough for us to approach sufficiently near to see them.

I learn from good authority, at Cohas-

set, that the structure was seen standing at 5 o'clock, p. m., on the 16th inst., although during that day a deck which had been secured on the second series of horizontal stays by Mr. Dunham (the former keeper) had come ashore. If this deck was washed from its position, the sea must have run to within 5 or 6 feet of the base of the house, and must have tried the structure very much during that day, as the height of the storm was on that day, between 11 and 1 o'clock.

I also learned that the light was seen as late as ten o'clock on the night of the 16th instant; and at about one o'clock on the morning of the 17th instant the lighthouse bell was heard, at Cohasset, to ring very distinctly; and that is supposed, by the Cohasset people, to be the time the structure was carried away, it being then high tide.

I think this deck or platform, mentioned above as coming ashore during the day, should never have been placed there—and I told Mr. Dunham so at the time—as it was strongly secured between the piles, and would cause great resistance if the sea should ever reach to its height. Another thing which was very injurious to the structure, and which should never have been allowed to remain there, was a guy which run out to the northwest from the structure. This guy was of $5\frac{1}{2}$ inch hemp rope, about 50 fathoms long, one end made fast to the lantern deck, and the other to a stone in about 5 or 6 fathoms of water at low tide. This stone was brought from Quincy for the purpose, and weighed, as Mr. Bennett informed me, upwards of *seven tons*.

The guy must have strained the structure badly in a common running sea; but in such a tide and sea as on this occasion it must have been a tremendous strain, as it was made fast so high up, and running out at right angles with the direction of the running sea, thereby receiving as great force from the sea as possible.

Mr. Bennett informed me that he always slackened this cable down in a storm, in order that it might not have so much influence on the structure; but this I think was of no use. It merely let more of the rope into the sea; and, in some instances, would have worse influence on the structure than if it were kept taut.

I cannot but think that, if the lower

series of diagonal stays had been put on, the structure would have been standing at this time. As it was, it stood through the worst part of the storm and the highest of the tide; and the people of Cohasset told me that, as they had seen the light standing at five o'clock the afternoon before, they had concluded the danger was passed; but, on the morning of the 17th instant, it was found that the lighthouse was gone.

I am, very respectfully,

Your obedient servant,

WILLIAM DENNISON.

Captain W. H. SWIFT, Boston.

We annex the newspaper article referred to in the above correspondence :

GLADES, (COHASSET,) April 29, 1851.

EDITOR BOSTON HERALD:—Being in possession of what I believe to be a few facts in relation to the Minot's Ledge lighthouse, its destruction, &c., I deem it necessary that the public should become acquainted with them, as I have seen gross misrepresentations of the whole affair in the Boston prints for the last six months. Those who are acquainted with these facts as they exist, suppose that the structure was a frail one, and that its keeper had done much for the preservation of the lighthouse, his assistants, himself, &c.

This I believe to be a fact, so far as his own personal safety was concerned, otherwise, the improvements, as they have been termed, have without doubt been the means of the destruction of the light. I would ask any reasonable person who is acquainted with the case, if the structure should not have withstood the gale if it had shown a little less unnecessary resistance to the wind and sea? It certainly withstood the gale previous, and would undoubtedly have withstood the late gale if this resistance had never been placed upon it, as I am particularly acquainted with the manner in which the light was constructed, from the drilling of the holes in the rock up to the time it was completed and ready to be lighted up. I can give you some information respecting those things. There has been a large rope attached to the upper part of the structure, and leading to a heavy rock mooring on the in-shore side of the lighthouse. There has also been a stout

plank deck laid on the second series of braces. I recollect during the time of building there were strong planks lashed on the same place, which were broken and washed away by the sea.

There was also a large fog-bell, weighing some six or seven hundred pounds, attached to the structure underneath the building, which neither I nor any one else on the glades have heard ring, excepting on pleasant days and moonlight nights. These, with other things too numerous to mention, formed much unnecessary resistance, and were no doubt the means of the destruction of the lighthouse.

In contradiction to a statement I saw published saying that there was not a vestige of the light remaining, I would say that the posts are broken from the surface of the rock, in different lengths from one to ten feet.

I would also state that the keeper, instead of being washed from the house on the glades or white rock, was snugly in bed (or turned in, as we sea-dogs term it) at friend Perry's Commercial House, Cohasset, and knew nothing of the fate of his assistants, which he left on the light without any means of escape whatever, until he was called up in the morning and told that the lighthouse on Minot's rock had been swept away during the night. On Wednesday afternoon I was looking at the light several times with my spy-glass, and through that I could discover that the structure leaned in-shore considerable.

If this was the case, how must those poor fellows have felt; they certainly expected the light would go on the night tide; but they had no means of escape, or even making a trial. If I had been placed in their situation I should have considered, with the boat belonging to the light, that there was a good chance for me to get off and save myself on the ebb tide in the afternoon; at any rate I would have tried it, and no doubt the two assistants could have done the same.

N.

ROTATION OF THE EARTH.

We hear so much lately of the experiment of rendering the rotation of the earth visible by the comparison of objects on its surface, and have been asked

so often to furnish some demonstration of it, that we make no apology for the space occupied in this number by the subject. Conclusive as the demonstration may appear to some minds, there are those, and by no means of an inferior order, who withhold their assent to its accuracy—in fact some denying stoutly the facts, and others seeking for an explanation of them in some other phenomenon than that of the rotation of the earth. Luckily our kind mother will not stand still and wait for our decision; so that we are relieved of all fears of any catastrophe resulting from an erroneous conclusion in the premises. For all practical purposes, it matters not one straw whether the facts be so or not. As to any valuable deduction growing out of the experiment—such as a better determination of the figure of the earth, determination of latitudes, &c.—it is of no value whatever; as an amusing toy it is worth looking at, and as such we give it.

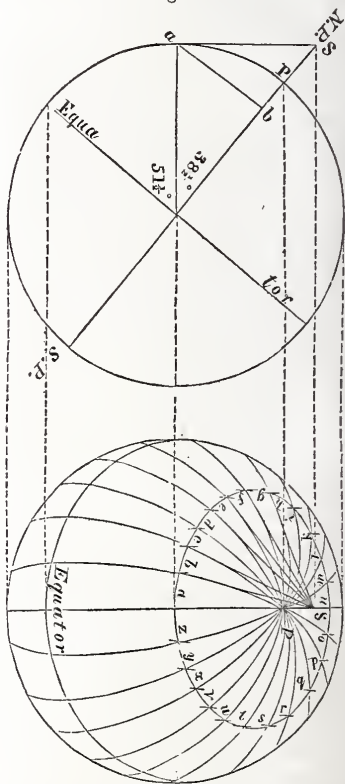
No. 1 is taken from the London Artizan.—No. 2 is, we believe, from the pen of Professor Horsford, of Cambridge, Mass., and appeared first in the Bunker Hill Aurora.

NO. I.

Fig. 1 is supposed to be a section of a terrestrial globe rectified for the latitude of London, that is, the crown of the circle represents that spot of the earth on which we tread, and the polar axis is therefore elevated so as to point to the pole star. Fig. 2 is the plan of the surface of the globe projected geometrically from the section in fig. 1. The meridians drawn in fig. 2 are 15° apart; the space between each corresponds to an hour of time in the diurnal rotation of the earth. It is obvious that a person stationed on that parallel of latitude marked a, b, c, d , &c., has not only a rotation round the polar axis, as he would have if placed on the equator, but he has also a radiating motion round the pole p . It is this radiating motion alone

that is shown in the experiment, and, therefore the experiment is of that nature as would show none of the rotation of the earth at the equator, although there the rotation is greatest in degree, whilst at the poles, where the rotation is least, but where it is *entirely radiating*, the experiment (if it could be conducted) would show the greatest result. Having

Fig. 1.



thus premised the general circumstances attending the experiments, we proceed to explain those which belong to our own latitude.

If a pendulum be taken from the ground, say at the position marked a , and, being affixed to a wire, made to vibrate north and south; and if it be of such length as to continue its vibrations for two or three hours without mechanical aid, it is evi-

dent that at the end of the first hour, the point of suspension of the pendulum will have passed from a to z . The direction of north and south will then incline to the former position, as ZP inclines to aP , whilst the motion of the pendulum will continue to be parallel to the motion it first started with at a , thereby apparently having altered the direction of its vibrations, when compared with surrounding objects. After the lapse of another hour, the point of suspension has travelled to y , whilst the direction of the vibration, being parallel to what it was at a , is twice as much inclined to the direction north and south, which is now yP . This deviation continues to increase as the hours pass on, until after a lapse of 6 or 7 hours, the direction of north and south, which is then tP , or sP , is nearly at right angles to the direction of the pendulum, and hence by the time the earth has completed one revolution, and the observer has again returned to a , the plane in which the pendulum vibrates has also nearly made a complete revolution.

We now proceed to point out how it is that the plane of the pendulum's vibration does not make a complete revolution in the time of one revolution of the earth (that is 24 hours), but in reality requires 30h. 40' to accomplish one revolution.

It is obvious that whilst, close to the pole, the hour meridians cross each other at an angle of 15° , yet that from the pole to the equator, the meridians acquire less and less inclination to each other, and thus the same meridians when crossing the equator are parallel to each other. If it be required to know the exact angle at which the hour meridians are inclined to each other at any given latitude, say that of London, draw a tangent as to the surface of the globe, fig. 1, at the given latitude, and produce this tangent until it meet the axis of the earth at S . Then all the meridians will be inclined to each other at the latitude a (fig 1.), just as if they were straight lines drawn from the point S . And because these meridians, if taken in a plane of direction perpendicular to the axis ab , would be always inclined $15^\circ 30''$, they would form with the radius as another angle, which would bear the same proportion to 15° , as as to ab . Those lines may either be measured geometrically by a scale of equal parts, or may be

taken from a trigonometrical table of sines, &c., observing that ab is the cosine, and as the cotangent of the latitude of the place. Thus, for $51\frac{1}{2}^\circ$, the latitude of London, $ab = .6225146$,

and $as = .7954359$; and therefore $.7954359 : 15^\circ :: 6225146 : 11^\circ.74$, which is the real angle at which the hour meridians are inclined to each other in our latitude, and consequently, the angle which the "north and south direction" gains on the plain of the vibration of the pendulum every hour; and therefore

$$\frac{360^\circ}{11^\circ.74} = 30 \text{ hours } 40 \text{ minutes,}$$

being the time during which the plane of the pendulum will have completed one revolution.

It may be further remarked, that whilst the observer has travelled from a to z in one hour, the point of suspension of the pendulum has done the same; and therefore, it is only the "twisted part" of that motion which is revealed by the pendulum from time to time. If, therefore, a board be placed underneath such a pendulum, and the centre below the pendulum, when it is at rest, carefully marked; and if from this centre radii be drawn on the board, say every 5° apart, then, if the pendulum be put in motion, it will always cross the centre marked on the board, exactly, but every 25 minutes it will be found to have changed the plane of its vibration, so as to move along another pair of these radii.

Neither is it of any importance, whether the direction of the pendulum is begun from north to south, or from east to west, or in what direction it begins to vibrate, as it will in all cases have changed its first motion, to a path at right angles with it, in 7 hours 40 minutes.

We have tried this experiment with a fine wire 40 feet long, to which a ball of 6 lbs. weight was suspended. After striking some chalk lines on the floor underneath the ball, radiating from it as a centre, the ball was drawn back by a small cord, and when all lateral vibration had ceased, the cord was burnt through by a lighted candle. The ball thus launched itself forth with perfect steadiness, and continued to vibrate for about $3\frac{1}{2}$ hours, by which time the apartment had evidently slued round (as the sailors would say) 45° .

NO. II.

In the great experiment of Foucault, the motion of the pendulum at the pole is not difficult to conceive. The plane in which oscillation takes place, not revolving with the earth in its motion from east to west, the pendulum will, at each returning sweep, approach an observer from a new point; or in other words, the plane of oscillation will revolve, and in twenty-four hours will have accomplished a revolution around the earth's axis.

The motion of the pendulum at the equator is easily presented. By the law of inertia, the absolute direction of the plane of oscillation will be, throughout the revolution of the earth, that in which the motion of the pendulum commenced. If it coincide with the equator, at the outset, it will continue to do so. If it be at right angles to the equator, the same rule will apply. Any given direction will be maintained till the pendulum comes to rest. The plane of oscillation will not revolve around its own vertical.

The motion of the pendulum, at a point between the pole and the equator, is less easily explained.

It is influenced by so many varying conditions that a strictly true mechanical conception of it may be impossible. As yet, the more gifted mathematicians have not attempted to present it in a detailed form, suited to the general comprehension. While we wait for their patient and more thorough investigation, it may not be unwise to avail ourselves of such illustrations as may be approximately correct, and possibly prepare for more profound and accurate views when they shall be offered.

With these considerations the following is submitted:—

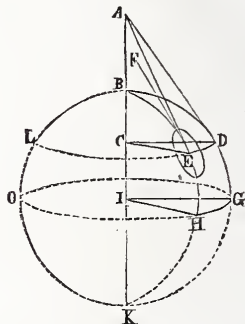
The accompanying diagram represents the earth. $A K$ is its axis; $G H$ its equator, and $D E L$ the meridian of latitude of Boston. $B D G$ and $B E H$ are the two meridians of longitude fifteen degrees apart, and $D A$ and $E A$ are tangents to these meridians, at the points D and E .

A pendulum at the pole making its first oscillation in the meridian $B E H$ at the end of an hour, would vibrate in the meridian $B D G$. The plane of oscillation would in this time have swept over 15 degrees—the 24th part of 360 degrees; an angle equal to $D C E$, which measures

the inclination of the two meridians to each other.

A pendulum at D , in the latitude of Boston, for example, oscillating in the meridian $G D B$, at the end of an hour would have moved with the earth in its revolution to E ; but preserving the original direction of its oscillation, it would

Fig. 2.



not vibrate in the meridian $H E B$ but in the direction of $E F$ parallel to $D A$.* This direction makes with the tangent of the meridian the angle $A E F$ —the portion of 360 degrees through which the plane of oscillation revolves in the latitude of Boston in an hour. 360 degrees divided by this angle will give the number of hours required for a complete revolution. If the angle be less than fifteen degrees, the revolution of the plane of oscillation will require more than twenty-four hours.

Now although not strictly true, the three lines $E A$, $A D$ and $F E$, may be regarded as lying in the same plane, and the angle $D A E$ as being therefore equal to its alternate angle $A E F$. But the angle $D A E$ is less than the angle $D C E$, because of the triangles $D A E$ and $D C E$ having the same base, $D A E$ has the greater altitude. $A E F$ being equal to $D A E$, $A E F$ is less than $D C E$. But $D C E$ is fifteen degrees, the inclination of the two meridians to each other. Three hundred and sixty divided by this quantity, which is less than fifteen, will give a quotient greater than twenty-four.

* Strictly speaking, the direction at the second meridian is not absolutely the initial direction. The straight lines may nevertheless be regarded as giving the sensibly correct path of the pendulum.

The lower the latitude, that is, the nearer the line DE is to the equator, the less will be the angle DAE and of course the angle AEF , and the greater will be the quotient arising from the division of 360 by this angle. At the equator where the tangents to the meridian no longer converge but are parallel, the angle will be reduced to zero, the quotient become infinity.

The path of the pendulum in latitudes between the pole and the equator may be thus illustrated:

Upon a globe a foot or more in diameter, having upon it the hour parallels, small circular discs having a straight dark line through the centre (gum-tickets such as are used for price-marking by merchants answer the purpose well) may be attached in the following manner:

In the latitude of Boston, for example, attach the first ticket with the straight line north and south. This line will represent the sensible path of a pendulum made to vibrate north and south in this latitude. Place the second ticket upon the next meridian eastward, the line upon it being parallel to that on the first ticket. This line will represent the sensible path of the pendulum at the end of the first hour's vibration. The third ticket is to be placed on the third meridian, its line being parallel to that on the second, and so on around the globe, the straight line on each succeeding ticket being parallel to that on its predecessor. The straight lines will give the path of the pendulum as it passes each succeeding meridian.

It will be observed on attaching the 24th ticket, that the line which represents the path of the pendulum at the commencement of the 24th hour of its vibration, is not parallel to that on the first ticket. The line will not have completed a revolution around its centre. Now with a pencil continue the parallel lines across the tickets already attached, each succeeding line being, as before, parallel to its predecessor, and it will be found that about twelve of the tickets, an hour apart, will have been crossed, before a north and south line will be drawn. In other words, it will appear that about thirty-six hours are required in this latitude for the plane of oscillation to complete a revolution about its own axis.

A large orange and wafers, crossed by straight pencil mark, may be substituted

for the globe and gum-tickets, and the general illustration very well given.

E. N. H.

Cambridge, May 23d, 1851.

NO. III.

For Appleton's Mechanics' Magazine.

It appears to me, that those who assert the pendulum experiment is a visible proof of the rotation of the earth on its axis, have jumped to a hasty and premature conclusion. If the experiment had been made at one of the poles, we could imagine how it must take place; but, I have utterly failed in making a model where by any possibility the result could be produced in our latitude; and I think any one who attempts to verify its mode of operation in this manner, will encounter a similar defeat.

The foundation of the theory is an unjustifiable assumption, viz.—that the friction of a steel point resting on a hard bed is nothing, so that the bed may revolve at the rate of one revolution in 24 hours without carrying the point through the same course. Till some man has performed the astonishing feat of making a point so fine that it has no friction, we may very safely doubt all theories which rest on such an assumption.

Further, it is physically impossible that the pendulum could remain stationary as represented. If the earth carried the pendulum in its diurnal course, we could conceive how the pendulum might be removed from the influence of the earth and remain stationary; but it is as correct to say, that the pendulum carries the earth as that the earth carries the pendulum: the truth is, each one proceeds on its own course; each individual molecule of matter has certain properties imparted to it by its creator, so that each one keeps on its course, and no one molecule can assert superiority over any other and say, I carry and support you. The oxygen, carbonic acid &c. of the atmosphere, move in their orbits because it is in their nature so to move, and not because they are dragged per force by the solid globe. They continue their diurnal and annual motions, whether they are in a state of vapor, or in the shape of water or solid rock, and so long as they retain their present nature they must continue on their daily motions, whether suspended by a 30 foot wire in the shape of a pendulum,

or shut up in the lowest depths of the earth. Suspending a piece of matter in the shape of a pendulum cannot alter its nature, therefore I conclude that the appearances in the pendulum experiment do not proceed from the pendulum ceasing its diurnal revolution with the rest of the globe. An explanation of the phenomenon described must be sought elsewhere.

C. D.

Newark, N. J.

WARMING BUILDINGS.

We were called to examine a new warming apparatus recently patented by Mr. Lyman, of Brooklyn, and were much pleased with its simplicity, economy, and effectiveness.

It consisted of a large number of glass tubes several feet in length, standing perpendicular and inclosed in a box; their upper ends passing through holes in the bottom of a shallow cast-iron pan which is called the steam chamber. Their lower ends are open and unconfined, sliding freely through holes in a plate across the bottom of the box; these holes merely act as guides, and permit free expansion and contraction of the tubes in length without straining the upper joints.

The distilled water, the product of the steam from a common boiler, which being condensed in glass tubes is of course perfectly pure, drops slowly from each tube into a shallow pan of stone or one lined with hydraulic cement; from this it runs by a tube to a cistern for family use, or where more is distilled than needed it is permitted to run by a branch pipe to the boiler, to be again evaporated.

There is never more than single atmosphere pressure in the boiler, for the steam escapes freely into the chamber of the heater, from this freely down through all the glass and tubes.

The action of the apparatus depends upon the fact that the specific gravity of steam is less than that of air: twelve cubic inches of air weigh about three grains, and the same amount of steam about one and a half grs.; consequently it requires a pressure of about one and a half grains in the steam chamber to force the steam down one foot, or three

grains to force it down two feet in the glass tubes; and so perfectly do these light fluids obey the laws of gravity, that the steam passes down each tube an equal distance. The lower ends of the tubes are therefore left open to the atmosphere, and no steam escapes if there is tube-surface sufficient for the boiler surface.

Its operation is as follows: when the fire is started, and steam begins to rise from the water, it passes to the reservoir; here it is condensed for a few moments until the reservoir is heated, when it makes its way down all the glass tubes at the same time, an equal distance down each. As soon as the upper ends of the tubes are heated, the air around them is heated, and begins to rise and pass out of concealed openings near the top of the box, and its place is supplied by the cold air which rushes in under the base.

Although these tubes are so closely arranged that a box six feet high and twenty inches square contains one hundred and twenty tubes measuring one hundred square feet of heating surface, which by the common estimate is sufficient to warm eighteen thousand cubic feet of space, or two stories of an ordinary house, yet they are so arranged that a dozen tubes could be removed and new ones substituted in their place in an hour, or if one should be broken a cork or ball of hydraulic cement might be introduced in its place in a minute, and several of them might be closed in this way without sensibly affecting the power of the heater. But the tubes being thin are certainly not liable to be broken by heat, and we are informed that not one has ever been broken while in the box; we conclude that it is not liable to become disordered, and if disordered, it is certainly easily repaired.

They are being constructed of different sizes and forms, and are recommended as a cheap and reliable means for diffusing a mild and moist warmth throughout a house.

We recommend to such as are building, and who have an eye to next winter, to examine Lyman's apparatus before putting in the heavy and costly furnaces.

M'CURDY'S IMPROVEMENT IN PREPARING INDIA-RUBBER.

From the specification of the Patentee.

MY invention consists in the discovery of new ingredients to be mixed with India-Rubber, which will cause a great improvement upon its strength and durability and contractile force, and overcome the difficulty hitherto resulting from the necessity of treating most fabrics of rubber with steam, during the process of vulcanizing.

It is well known, generally stated, and I believe it to be true, from my own extensive experiments, that under all modes of treatment hitherto known, none has been discovered by which the change called vulcanizing could be produced, by exposure to a heated atmosphere, without the use of lead, or its oxides or preparations, and the injurious effects of which have become so well and generally known, that particular reference to all of them would be quite unnecessary.

Fabrics of rubber, combined with lead preparations, become spoiled upon exposure to the sun and weather, for a period varying from two to six months, when they become charred and lose their elastic properties.

The ordinary exposure in the shade, results in a bloom or white powder upon their surface, which renders articles thus made, unsalable in the market.

My experiments have resulted in the discovery, that common commercial potash, mixed with rubber, in proportion as small as two ounces of potash to sixteen ounces of rubber, when treated by mixing of the usual quantity of sulphur—say from 5 to 7 per cent., by weight, to the quantity of rubber used—will readily vulcanize, upon exposure to a heated atmosphere, say 260° Fahrenheit.

I find a tolerable good result can be obtained by the use of carbonate of potash, or soda and caustic potash, or caustic soda; but I prefer the common commercial potash, for its cheapness, and because it produces the best results.

The quantity of potash may be increased—the exact amount is immaterial—but the best elasticity I obtain by the use of two ounces to sixteen of rubber.

This preparation may be spread on fine figured or colored textile fabrics, and exposed to a heated atmosphere, without in the least discoloring, or causing the loss of color to the fabric. It is free from

offensive sulphur smell, and will not be affected by atmospheric changes.

For making my fabric harder, and with less elasticity, as also for purposes of cheapness, I combine lime whiting, Paris whiting, lamp-black, and such articles as are well known to give body and firmness to the rubber. These may be incorporated with the potash and rubber compound, by the usual methods well known to manufacturers.

The mixture of sulphur to be done as is usual in other preparations of rubber, well known to rubber manufacturers. I prefer to incorporate it while grinding the rubber. All my ingredients are to be incorporated and the rubber treated in the ordinary way known to manufacturers of vulcanized India-Rubber.

BARANOWSKI'S PATENT NUMBERING, STAMPING, AND REGISTERING MACHINE.*

The several machines patented by Mr. Baranowski are all dependent on one particular arrangement of wheels or discs, of which he gives the following preliminary description:

The wheels or plates *d* and *b*, Fig. 2, turn on their centres *B* and *A*, and when the tooth *e* falls into one of the notches in *b*, it moves *b* round one-tenth of its circumference, as there are ten notches in the wheel *b*. The spaces between the notches in *b* are arcs of the same circle as *d*, so that *b* is always stationary and fixed, except when moved by the tooth in *d* once for each revolution of *d*. *b* is fixed to *a*, the edge of which is engraved with the figures from 0 to 9, as shown in fig. 1. The cogged wheel *c* is also fixed to *a*, and works into a cogged wheel of the same size *f*, turning on the same centre as *d*, the edge of which is also shown in fig. 1. *d*¹ is fixed to this last cogged wheel *f*, and is of the same form and size as *d*. *b*¹ is fixed to *a*¹, the edges of which are shown in fig. 1, and is of the same form and size as *b*. Again; fig. 1, *b*² is fixed to *a*², and is turned by *d*², which is fixed to *f*¹, working into the cogged wheel *c*¹; *b*² and *d*² are also of the same size and form as *b* and *d*. *a*¹ and *a*² have also the figures from 0 to 9 engraved upon their edges. All the

* From the London Mechanics' Magazine.

Fig. 1.

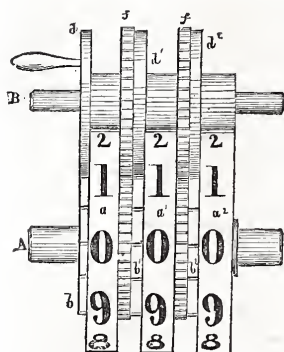


Fig. 2.

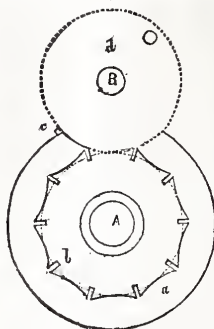


Fig. 3.

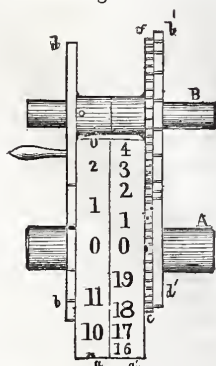


Fig. 4.

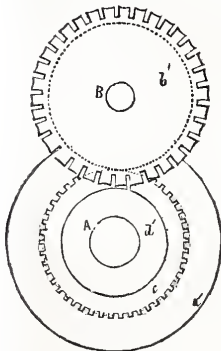
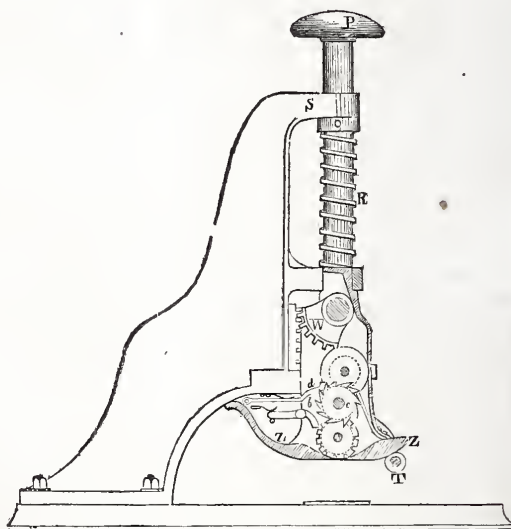


Fig. 5. i



plates or wheels move freely on their cylinders or centres, A and B respectively, although it will be seen that no one of them can move without moving all the others, at intervals of time dependent upon the number of notches in the wheels b , b^1 , and b^2 respectively, and also upon their respective distances in the arrangement from the first mover d . The operation of counting proceeds thus:—The first revolution of d moves a one-tenth, or puts the unit in the place of the cipher on a ; ten revolutions of d , or one of a —that is,

one revolution of d^1 (for the cogged wheels are equal in size) moves a^1 one-tenth, or puts unity in the place of the cipher on a^1 , or shows ten where there is 0, 0, 0 in fig. 1. One revolution of a^1 , that is, one revolution of d^2 (for the cogged wheels are of the same size) moves a^2 one-tenth, or puts unity in the place of the cipher on a^2 , or shows one hundred where there is 0, 0, 0 in fig. 1, and so on till the arrangement shows 9, 9, 9 where is 0, 0, 0 in fig. 1.

It is obvious that the notches in b , b^1 ,

Fig. 6.

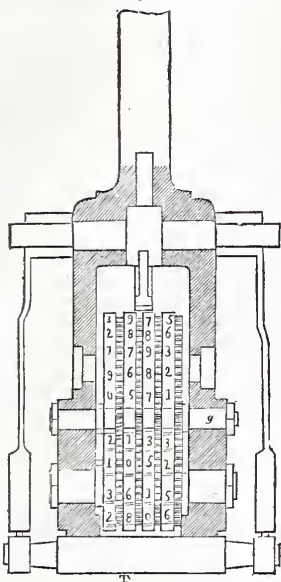
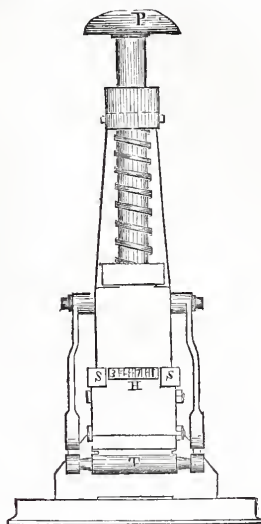


Fig. 7.



and b^2 need not be each ten in number, nor need there be precisely such three wheels; but there may be, for instance, only two (see figs. 3 and 4), b having twelve notches, and b^1 twenty notches; and in such a case, the numbers on the edges of a and a^1 might represent shillings and pounds. It will also be seen, by examining the figs. 1 and 3, that fig. 3 differs slightly from fig. 1, without affecting the peculiar character of the arrangement. The same letters show the same parts in both figs. b , the unit wheel a , and d^1 are all fixed to the axle Δ , which turns upon its centres. In fig. 1 the corresponding wheels are loose on Δ ; d^1 works into b^1 , as in fig. 1; and as f is fixed to b^1 , and c to a^1 , and f and c are of the same size, and work into each other, every complete revolution of a is attended with a partial revolution of a^1 through a space measured by the distance between any two notches in b^1 , fig. 4. The object of this variation in the figs. 1 and 3 is to bring the numbers on the edges of a and a^1 close together.

Again; if d had two teeth, two notches of b would be moved round at each revolution of d , and the odd or even numbers on a would be presented from time to

time where there is now 0, 0, 0, fig. 1, according as the arrangement was started with 1 or 2. If started with 1 it would skip 2, 4, 6, &c., and show 1, 3, 5, &c.; if started with 2, it would skip 1, 3, 5, &c., and show 2, 4, 6, &c. The Roman method of notation, or any other signs or symbols expressive of numbers, can be substituted for the Arabic figures, and can, by means of this arrangement (modified so as to facilitate and vary its application), be made to appear at 0, 0, 0 (fig. 1).

The manner in which this simple and ingenious arrangement is applied to the numbering, stamping, and registering railway tickets (for example), is thus described:

Fig. 5 is a sectional view of the side of a machine of this description. $R R$ is a cylinder which is movable up and down in the frame $s s$. The top r , upon which the blow with the hand is to be given, is always kept up some distance above $s s$ by a spiral spring upon $R R$. The whole of the machinery forms part of $R R$, and moves up and down with it, except the rack x , and the clicks b and d , which are fixed to $s s$. When $R R$ is struck down, a tooth of the wheel c passes beyond b , and when $R R$ rises again to its place, the

wheel *c* is turned one tooth by the position and resistance of *b*; *d* is a click to keep *c* fixed, as *R R* descends. The arrangement here is the same as shown in fig. 1, only there are four wheels with figures on them instead of three, as the number shown is any sort of ten thousand. There are also two sets of figured or marked wheels, one above the other, and made to move at the same time by the cogged wheels on the middle axle *g*, figs. 5 and 6. On the lower set the numbers project to be used as stamps, the neighboring parts being cut away as shown in the wheel *h*, fig. 5. The upper set appear at *H*, fig. 7, so that each number from time to time is both stamped and registered. The segment of a wheel *w*, fig. 5, to which is fixed an arm carrying a small elastic roller *T*, works into the rack *x*, and at each descent of *R R* is thereby carried over the underside of the apparatus *z z*, and this surface being charged with printing ink, the roller *T* inks each projecting figure before it reaches the paper below.

CIRCULAR SAWMILL.

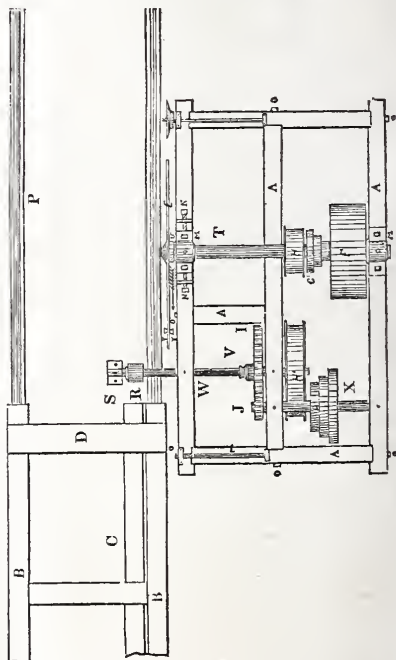
WILLIAMSPORT, Pa., May 18th, 1851.

Mr. Editor:—As I am a close reader of your excellent Magazine, and have seen no notice of the great improvement in Sawmills, I have thought an article from a working man would be acceptable.

The above is a plan of a circular sawmill. *A* is the frame in which the saw and feed-gear are fixed, *B* part of the carriage, shoved back so as to show the gig-back pinion *R*. *C* a piece fixed on the bottom of the carriage on which the cog segments are fixed, that gear in with the pinion *R*. *D* the head block, the fixtures for setting not shown, *E* the saw moving in the direction of the arrow, *F* the driving pulley—*G G'* cone pulleys which regulate the feed, *H H'* pulleys which drive the gig back after each board is cut, having flanges on their edges to prevent the strap from running off of them while the saw is cutting—*I* cog wheel running loose on the shaft *w*, *V* a clutch which revolves with the shaft *w*, and fastens into the one on the wheel *I*, and is thrown in or out of gear by a lever not laid down—*J* a pinion which works into segments on the under side of *c*, and moves the carriage to or from the saw. *S*, box and bearing

of shaft *w*, *L* roller, *M M* plumber blocks for saw mandrel *T*, *O* bolts by which the frame is held together, *Y Y* guides for the saw, *P* iron ways on which small rollers are fixed on the under side of the carriage, *B* run, *K* revolving wedge, *N N* set screws.

To work the mill, set the saw by the screws *N N* so that the edge of the saw nearest *K* be about $\frac{5}{8}$ of an inch further from *D* than the opposite edge: this is to prevent the belt of the saw from catching the log after it runs past the cutting edge; the revolving wedge *K* keeps the board from catching in the saw. The driving pulley *F*, together with its shaft and saw, being set in motion in the direction of the arrow, the strap from *H* to *H'* being loose, and that one from *G* to *G'* set to either of the different feeds. The shaft *x* with its pinion *J* revolves in the same direction as the strap and gearing into the wheel *I*, now fixed by the clutch



v; the shaft *w* and pinion *R* are made to revolve in a direction opposite to that of the saw, and *R* being in gear with the cog-segments on the bottom of *c*, the car-

riage and log are forced upwards to the saw.

After the log has passed the saw and the board is removed, the clutch *v* is thrown out from the wheel, allowing it to move freely round on its shaft, and the tightner left down on the strap from *h* to *h'*, causing *h'*, its shaft *w* and pinion *x* to move in an opposite direction to the saw, and move the carriage and log back to their first position.

A mill like the above, driven by a 20 horse power engine, is now cutting 10,000 feet of 1 inch oak boards per 24 hours. The saw runs 450 revolutions to the minute, and cuts $\frac{3}{8}$ of an inch to the revolution. The lumber cut by these mills is much smoother and has no stump shot, and is worth some \$2 per thousand more at market than that cut in the old way, with a frame saw. A frame saw, driven by the same engine, we would calculate to cut from 5 to 6 thousand per 24 hours. I heard, the other day, one of Mr. Paine's arguments used in favor of these mills; it was an offer of a bet that the above mill would cut six thousand feet of 1 inch oak boards in six consecutive hours. The forfeit was \$6000, and it was not taken up.

The first cost of these mills is much less than that of the common ones. The saw, all the iron work, and the frame in which it runs, and the carriage and its iron work, are made by Messrs. Hall & Montgomery, of this place, for, I believe, about \$350. From there being no jarring motion, the building need not be near as strong as for other mills.

HENRY F. SNYDER.

ON THE IMPROVEMENT OF THE CONSTRUCTION OF RAILWAY CARRYING STOCK.*

BY W. W. ADAMS.

In a previous paper laid before the meeting of the Institution, the great increase was pointed out that has gradually been made in the dead weight of the carrying stock in the general practice of railways; that the First Class Carriages carrying 18 passengers have been increased in dead weight from $3\frac{1}{4}$ tons to 5 tons; and the wagons carrying a maximum load of 4 tons have reached a dead weight of $4\frac{3}{4}$ tons, and that this great increase of dead weight occasioned an important

addition to the cost of locomotive power for the net load carried. If a locomotive engine is capable of conveying a train of 50 wagons, weighing 200 tons, and the load 200 tons (which proportion of dead weight to load will not be short of the truth, even without taking empties into account), a saving of *one ton* in the dead weight of each wagon will enable the engine to convey 50 tons additional of wagons and load, or equal to a saving of *one-eighth* in the cost of haulage.

In the important matter of inland through coal traffic, the wagon averaging $3\frac{3}{4}$ tons carries 5 tons of coal; but as the wagon has to return empty, for five tons of load conveyed one mile, $7\frac{1}{2}$ tons dead weight of wagon has to be conveyed the same distance. In this instance the saving of *one ton* weight in the construction of the wagon would be equivalent to a total saving of nearly *one sixth*, or 16 per cent. in the cost of haulage.

The great increase in dead weight has arisen from the increase that has been continually making in the quantity and weight of material employed in the construction of railway carriages and wagons, as the remedy for the failure of their different parts; that remedy having generally been solely increase of weight of material, without alteration of material or construction.

In the common road vehicles, where the motive power was limited, the road imperfect and gradients bad, the cost of hauling power was of so great importance, that every pound of weight was carefully saved in the construction of the vehicles, by using only the best materials and construction to obtain the strength with the least weight; the durability being comparatively a secondary consideration. The four-horse coach, conveying 18 passengers, weighed only 1 ton, and the van, conveying 6 tons of goods, weighed about $1\frac{1}{2}$ tons.

The great distinction between road and railway vehicles is, that railway vehicles have to sustain longitudinal strains in the direction of the buffing, as well as lateral and perpendicular blows. The reduction of the dead weight of railway vehicles is extremely desirable, while such reduction of weight is effected with due regard to efficiency and strength to resist the longitudinal strain in buffing, as well as the

* From the Civil Engineer and Architect's Journal.

other strains to which they are subjected. The object is to produce such vehicles as shall be, all points considered, the most economical in first cost, in maintenance, and especially in traction: and at the same time it does not follow that reducing the dead weight, and improving the quality of the materials, will add materially, if any, to the cost.

The *Sole-Bar* is the most important part of the wagon under-frame, as it resists the main force to which the wagon is subjected, namely, the longitudinal buffing, and also acts as a girder to carry the load upon the springs. The ordinary wood sole-bar averages from 10 to 12 inches deep, and $3\frac{1}{2}$ to 5 inches thick. Although the principal strain is the end-way buffing, the vertical strength is required to be so much greater than the lateral strength, in consequence of the sole-bar being strutted horizontally by the internal framing.

The writer has endeavored to discover the best form to attain the same strength in wrought-iron with the least material, and thereby ascertain whether the same strength can be attained with less weight than the ordinary wood sole-bar.

Fig. 1 (solid) is a section of the ordinary English oak sole-bar, of the average dimensions, 11 inches deep and $4\frac{1}{2}$ inches thick; the length is 13 feet, and the total weight, by actual practice, 321 lbs.

The correct theoretical section for wrought iron to answer the same purpose with the least material, would appear to be a box-girder, as shown in section in the same figure. But this cannot be practically adopted, as it would be next to impossible to manufacture, and it is necessary that some practical form of rolled iron be adopted, for economy and simplicity of construction.

The main force to be resisted is the end-way buffing, and as the strongest form to resist end pressure with the least material would be a tube (as shown dotted in Fig 3), that section which imitates a tube the nearest will be the correct form. The strength of the tube arises from the metal being distributed at the greatest distance from the centre; therefore in the section, Fig. 3, the metal has been principally distributed in three points of the circumference of the circle which are connected by the thin sides of the iron.

Inasmuch as the vertical strength is required to be considerably greater than the lateral strength, this theoretical section, Fig. 3, requires altering to the proportion shown in Fig. 4.

The practical section proposed to be adopted on this principle is shown in Fig. 3 by the white line; the height is 7 inches and the width 4 inches; the sides should be as thin as practicable, and the metal thrown into the extremities; the sides are therefore $\frac{5}{16}$ inch thick, and the extremities $\frac{7}{8}$ inch thick. The weight of this section, 13 feet length, is 219 lbs., being nearly one-third less than the ordinary oak sole-bar, which weighs 321 lbs.

The following experiments have been tried by the writer to ascertain the requisite strength of iron to be employed for this purpose.

An English oak sole-bar, 10 feet long, and of the section, Fig. 1, of picked quality and straight grained, was subjected to end-way pressure in a hydraulic press, being supported only at the two ends.

15 tons, deflected it $\frac{3}{8}$ inch at the centre.
22 $\frac{1}{2}$ tons, deflected it $\frac{1}{2}$ inch at the centre.
30 tons, deflected it $\frac{3}{8}$ inch at the centre.
35 tons, deflected it when it broke.

The breaking did not appear to be caused by deflection, but by the crushing and lateral separation of the fibres; the principal fracture being several feet in length and extending from side to side on the edgeway of the timber.

A wrought-iron bar, of the Great Western section, shown in Fig. 6, and the same length, 10 feet, was fixed in the same manner.

15 tons, deflection none.
19 tons, deflected it $\frac{1}{4}$ inch, without set.
22 $\frac{1}{2}$ tons, deflected it 4 inches, permanent set $2\frac{3}{4}$ in.

The deflection was entirely lateral, and in the direction of the arrow, or towards the side of the larger flange.

This bar is made of two pieces riveted together, one 7 inches high and $\frac{1}{4}$ inch thick, with a small flange on one side, and an angle iron, 3 inches wide, is riveted to it on the opposite side.

To ascertain the comparative vertical strength, an English oak sole-bar of Fig. 1 section, was placed edgeways on two supports, 6 feet apart, and the force of the press applied in the centre.

- 10 tons deflected it $\frac{1}{2}$ inch.
 12 tons deflected it $\frac{5}{8}$ inch.
 16 tons deflected it broke it.

The wrought-iron bar Fig. 6 section, was tried in the same manner, with the force applied on the edge, and supported on the flange.

- 10 tons deflected it $\frac{1}{4}$ inch.
 12 tons deflected it $\frac{1}{2}$ inch.
 permanent set $\frac{1}{8}$ inch.

From the results of these experiments it appears that the iron bar, Fig. 4, is about as strong as the wood sole-bar, Fig. 1, to resist vertical force, but

were all one solid bar of iron. It appears from the following experiment that the deflection would be on the *opposite side* to the large flange, if the whole were solid.

A bar $7\frac{1}{2}$ feet long of the section, Fig. 7, was subjected to end-way pressure in the same manner as before; the depth was 6 inches, the width $3\frac{1}{2}$ inches, and thickness $\frac{5}{8}$ inch.

23 tons produced no permanent set.

26 tons produced a permanent set of $1\frac{3}{4}$ inch laterally, and $1\frac{1}{4}$ inch vertically, the deflection being on the *opposite side* to the flange, as shown by the arrow.

Also a bar $5\frac{1}{2}$ feet long of the section, Fig. 8, was tried in the same manner by end pressure; the depth and width were both 3 inches, and the thickness $\frac{3}{8}$ inch.

9 tons produced a permanent set of 1 inch, both laterally and vertically the same, the deflection being in the *opposite direction* to the flanges, and diagonally as shown by the arrow, from the depth and width being equal.

From these results it appears that the two edges of the bar became compressed by the pressure more than the rest of the section, and allowed the bar to bend outwards. These edges are consequently strengthened in the proposed section, Fig. 7, by increasing the thickness, which will diminish the deflection, and enable the bar to resist a greater end-way strain without permanent set.

The sectional area of Fig. 6, the bar first experimented upon, is $6\frac{1}{2}$ inches, that of Fig. 7 is $5\frac{1}{2}$ inches, and that of Fig. 4, (dotted), the proposed section, is 5 inches, but the latter is expected to be stronger than Fig. 6, on account of the greater power to resist deflection, from the edges being strengthened and the bar being made in one solid piece, and that it will prove amply sufficient for the requirements. An important circumstance in the comparison of strength between wrought iron and wood is, that with iron the full experimental strength is obtained in practice, but in wood the strength obtained in practice is considerably less than that shown by experiment, on account of the defects to which timber is liable and the mortices and bolt holes cut into it.

The writer is about to have a quantity of iron rolled to the proposed section, Fig. 4 (white), for the purpose of con-

Fig. 1.



Fig. 2.



Fig. 3.

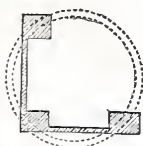


Fig. 4.



Fig. 5.



Fig. 7.

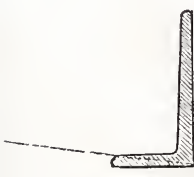


Fig. 6.



Fig. 8.



is somewhat deficient in strength to resist the end-way buffing. In this section a loss of strength is caused by its being made in two pieces riveted together; the deficiency is in lateral stiffness, which would be considerably increased if it

would be considerably increased if it

structing certain wagons, and hopes to be enabled previous to the next meeting to give the results of actual trial.

A very important advantage will be obtained by the use of iron from its greater durability. English oak, admitted to be the best material, cannot be procured in a thoroughly seasoned state in any large quantities, and is consequently, after it is made up, in a transition state for a term of years. The timber opens and shrinks, and the joints loosen, admitting wet and accelerating the decay.

Presuming that an efficient wagon frame be practicable from iron, it is difficult to place a limit upon the period of its duration, if well preserved from oxidation by paint or tar; and it may be expected to be still in an efficient condition at the time when wood requires renewal.

It should be noted that the English oak, weighing 72 lbs. per cubic foot, is in the unseasoned state in which it is generally used for wagons; and that as it seasons in work it lessens considerably in weight, but at the same time loses in strength.

The writer has not had the opportunity at present for carrying out his investigation into the application of iron to the construction of railway vehicles, further than the principal portions of the underframe, but proposes to continue the subject practically before the next meeting.



ALDRICH'S VACUUM PROPELLING WHEEL.

For Appletons' Mechanics' Magazine.

BY H. A. NORRIS, CIVIL ENGINEER.

Will any of our readers expose the fallacy of this argument in support of Aldrich's Vacuum Propeller? The determination of the proper form of water-wheels or propellers to sea steamers, is a subject of some importance just now:

The many inconveniences of the common paddle wheels, their bulkiness, exposure to injury, loss of power, and comparative inefficiency in rough weather, have been so constantly felt, that scarce a year has passed, since the first experiments in steam navigation, without persevering efforts to find a substitute. So

far, one only of all these contrivances, the screw propeller, seems to have secured a place upon the catalogue of useful realities. Let us see if Aldrich's vacuum wheel is not likely to prove a second, and still more valuable improvement.

Aldrich's wheel is a vertical paddle wheel, working in a tight case, nearly or wholly below the surface, and having only the bottom part of the wheel uncovered to the water.

The wheel itself has nothing complicated in its design or construction. A, fig. 1, is a hollow cylinder or barrel, revolving upon the main shaft as its axis; and to the circumference of the cylinder the floats or buckets B b, B b, are so attached, as to allow them to be removed whenever it becomes desirable to dispense with steam and use the sails alone of the vessel.

Fig. 2 shows the cross section of a vessel with the wheels in place. A A, are the cases; B B, the barrels of the wheels; the floats, or buckets, o o, when attached, project below the vessel.

This wheel is much smaller than the common paddle wheel, and capable of performing the same duty; and there ought to be a decided difference in the principles of their operation.

The common wheel, throughout three-fourths of its circumference, is immersed in air, and not only is there a loss of all the power absorbed by the resistance of that medium, but the air is *driven* into the water before each bucket, diminishing the density of the mass of water, and at the same time is *drawn* in behind the bucket, both by the atmospheric pressure and by the centrifugal force, allowing the bucket to be detached from the mass of water behind it. The centrifugal force has the further effect of driving the water towards the circumference of the wheel, materially sinking its level between the buckets, and diminishing the quantity upon which they act. A partial remedy for this is obtained by making wheels so large as to give the requisite velocity at the circumference, with a moderate number of revolutions each minute; avoiding in part the great centrifugal force which would accompany the same velocity in smaller wheels, revolving more rapidly. It also compels the employment of large buckets, capable of taking hold

upon a great quantity of the mixture of water and air bubbles upon which they act. It will appear, upon reflection, that if the buckets of such wheels were to be made much smaller than they now are, the resistance being much less, a greater velocity of revolution would follow; this again would drive increased quantities of air into the water, and dash it into foam, while the centrifugal force, augmenting

Fig. 1.

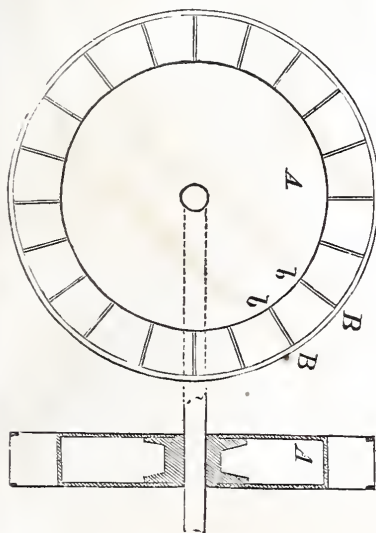
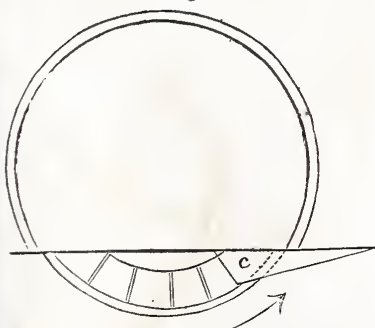


Fig. 2.



as the square of the velocity, would depress still lower the level of the mixture between the buckets.

It is a law, perfectly established, that to drag any surface like the bucket of a

wheel through water, the force required will be as the square of the velocity; that is to say, if it requires a force of one hundred pounds to move such a surface one foot a second, it will require four hundred pounds to move it two feet a second, and nine hundred pounds to move it three feet a second. This law holds good so long as the character and density of the fluid remain unchanged. But if the more rapid motion diminish at once the quantity and density of the mass acted upon, so far from the resistance increasing as the square of the velocity, it may, according to the nature of the case, not increase at all, or it may diminish. If, then, the buckets of an ordinary steam vessel are much too small,—if they slip or drag through the water too much, to give the necessary speed to the vessel, it will not remedy the defect to give an additional speed to the wheels; for that, as we have seen, may further diminish both the quantity and the density of the water acted upon, and thus diminish instead of increasing its resistance. Nothing less than enlarging the bucket, and perhaps the diameter of the wheel also, would remove the defect. Thus, the great dimensions of the ordinary paddle wheel, with all the attending inconveniences, necessarily arise from the immersion of the greater part of that wheel in air, through which each bucket must be rapidly driven before it can act upon the water.

Could a wheel be devised, which, though rapidly driven, would neither mix air with the water, nor lower the level of the water between the buckets, it is evident that such a wheel might be made much smaller, both in its diameter and in the surface of its buckets, than the ordinary wheel, and yet possess all the propelling action of the larger wheel; for, as neither the density nor the quantity of the resisting medium would be diminished, the resistance to slipping or dragging of the buckets would be in proportion to the square of the distance slipped over in a given time. Thus, if the buckets slipped 5 feet a second under the application of a propelling force of 100 horse power, they would slip only 7.05 feet under 200 horse power; 8.65 feet with 300; 10 feet with 400; and 20 feet with 1600 horse power. The law, that the resistance encountered by the buckets is proportional to the square of the velocity of their back-

ward slipping, at once explains the seeming paradox of the efficacy of the smaller wheel; and the fact that the buckets of the ordinary wheel, rushing from the air into the water, do not encounter any such resistance, equally explains why that wheel could not be effective if made as small as the other.

Mr. Aldrich's wheel, as before remarked, is a vertical paddle wheel, working in a tight case, nearly or wholly below the surface, and having about one-fourth of its circumference projecting below the case and uncovered for action upon the water. When in operation, the part within the case revolves in a vacuum, as we shall demonstrate.

Let us take for our example a wheel 17 $\frac{1}{2}$ feet extreme outside diameter, with floats two feet square, which would be large enough to propel a frigate. The centre of effort, or centre of gyration in each float, will be at a distance of eight feet from the centre of the wheel. The centrifugal force therefore, within the floats will be the same as if it were concentrated on the circumference of a circle of 16 feet diameter.

On the circumference of a circle 16 feet diameter, and making, say 34 revolutions a minute, the centrifugal force will be $\frac{3}{13}$ times the force of gravity, and will at the end of one second of time give a velocity of 100.74 feet instead of 32.2 feet, which would be the velocity conferred in one second by the force of gravity.

This centrifugal force drives the water from the wheel in radiating lines. It acts on each particle of water during its passage over the width of the bucket, imparting to it an accelerated motion expressed by the ordinary formula,

$$v = \sqrt{2gs}$$

which in this instance becomes,

$$v = \sqrt{2 \times 100.74 \times s}. \quad [1]$$

v representing the velocity acquired in passing over the width s , of the bucket; substituting this width, which is 2 feet, the equation [1] becomes,

$$v = \sqrt{2 \times 100.74 \times 2 \text{ ft.}}$$

effecting the multiplications indicated, and taking the square root of the product, we have,

$$v = 20.07 \text{ ft.}$$

for the velocity per second acquired in

the direction of radius by virtue of the centrifugal force on a circle of 16 feet diameter, making 34 revolutions a minute.

Again, as the vessel is advancing with a velocity, say of 15 feet a second, or rather more than 10 miles an hour, the water leaves the after part of the wheel with a velocity increased by this circumstance.

Suppose the water to be discharged from the floats just before their re-entering the case or box, at a distance of 45° from the lowest point of the wheel, then the velocity of 15 feet a second would have to be decomposed into two other velocities, one perpendicular to radius, the other parallel to it; the last of these, which must be added to that produced by the centrifugal force, is expressed by the equation

$$V = \sqrt{\frac{15^2}{2}} = 10.6 \text{ ft.} \quad [2]$$

adding to this 20.07 ft. already obtained for the centrifugal force, we have 30.67 feet a second for the velocity with which the water leaves the after part of the wheel, in virtue of the centrifugal force and the motion of the vessel.

The water being thrown out from the circumference of the wheel, is replaced by other portions, driven in between the buckets from the sides of the wheel by the force of gravity. This action of replacing continues until the buckets are about to re-enter the case, when they pass between a pair of metallic plates (*c* fig. 3), that completely intercept, on both sides, the current entering that part of the wheel; while, as we have seen, the water is issuing from the same part of the wheel at the rate of 30.67 feet a second. The cut-off plates cover about 20° of the circle of the wheel; and at the rate of 34 revolutions in a minute, it would require rather less than $\frac{1}{16}$ of a second, or .098 of a second for any part of the wheel to pass the cut-off. While, therefore, the space between two floats is passing the cut-off, the water in that space, moving 30.67 feet a second, will pass .098 $\times$ 30.67 or 3 ft., that is, it will pass a foot beyond the outside of the wheel.

But as the pressure of the atmosphere and column of water above act during this last named time as a retarding force, the formula

$$s = \frac{1}{2} g t^2 \quad [3]$$

will express the amount of this retardation.

Substituting for t .098 and for g the velocity 32.2 feet conferred in one second by the force of gravity, the equation [3] becomes

$$s = \frac{1}{2} 3.22 \times .098^2 = .15;$$

which deducted from 3 feet, leaves 2.85 feet for the space through which the water is thrown during the time the floats are passing the cut-off.

And the width of the bucket being but 2 feet, the water is thrown .85 of a foot beyond the wheel, as each float is about to re-enter the case. The water being expelled, the floats revolve within the case in a vacuum.

However rapidly this wheel might be driven, it is evident from the foregoing, that there cannot be any mixing of air with the water from its action. Neither can the quantity of water between the immersed floats be diminished; since a hydrostatic column of some 15 feet and the full pressure of the atmosphere in addition, are abundantly sufficient to replace, on the sides of the wheel, that is to say on the *ends* of the *floats*, all the water driven out by the centrifugal force until the cut-off plates are reached; and then the whole is expelled at once, leaving the floats to perform the remaining part of their revolution unencumbered and unretarded by either air or water. The density and quantity of water acted upon being preserved without diminution, the resistance to slipping must, as before remarked, be as the square of the space slipped over.

But the centrifugal force itself, in this wheel, adds a new element of resistance. The water in the lower part of the wheel is continually expelled by that force; and other portions, that have as yet acquired no backward motion, occupy its place. These last portions in their turn are acted upon by the floats, receiving a backward impetus, and at the same time acquiring the velocity of 20.07 feet per second in the direction of radius, as already demonstrated. Whatever slip the buckets make must be communicated to all the water that passes in and out of the wheel, as well as to that upon which the floats first strike. The resistance which, without this circumstance, was proportional to the *square* becomes, with it, proportional to the *cube* of the slip. If 100 horse

power caused a slip of 5 feet per second, it would require 800 horse power to effect a slip of 10 feet per second.

This rapid increase of power, as compared with the slip, makes it evident that almost any attainable amount of power can be applied, and effectually applied, to a wheel of this kind of very moderate size.

Compared then with the common paddle wheel, as to propelling qualities alone, Mr. Aldrich's wheel has these advantages.

1st. Within the case it revolves in a vacuum, and therefore moves without resistance.

2d. It mixes no air with the water, and consequently does not diminish its density.

3d. Its centrifugal force increases instead of diminishing the quantity of water acted upon.

4th. In virtue of the 2d and 3d items, the diameter of the wheel and the size of the floats may be greatly diminished without impairing the propelling action of the wheel.

As compared with the screw propeller it has these advantages.

1st. It has no cumbersome shaft and appendages projecting from the vessel aft, and extremely liable to become disabled by the grounding of the vessel astern, or by other external violence.

2d. With a wheel and a propeller of the same diameter and revolving with equal speed, the backward velocity of the floats of the wheel is about twice the backward action of the propellers' fans.

3d. A consequence of the preceding, the shaft of the wheel to produce an equal effect need revolve only about one half as fast as that of the propeller.

4th. A consequence of the preceding, the rotary velocity of the circumference of the wheel is but a fraction greater than the forward velocity of the vessel; while the rotary velocity of the circumference of the propeller is more than twice the speed of its vessel. The circumference of the Great Britain's screw revolved near 30 miles an hour, when the vessel moved but $12\frac{1}{2}$ miles. The difference in friction both upon the water and upon the journals is greatly in favor of the wheel.

It was my intention to discuss more in detail the action of the screw propel-

ler; also to call attention to the difference in the frame-work required to support the main shaft and appendages of a common paddle wheel some 15 feet above the surface of the water, and that required for a smaller and shorter shaft 6 or 8 feet *below* the surface of the water. But a want of time and the apprehension of drawing the subject out to an unreasonable length, have operated to prevent it. The amount of centrifugal force, and the formulas for accelerated motion, used in this article, have not been here demonstrated, as they are probably already known to all who would understand them if so demonstrated. Besides, the pages of a periodical are hardly the proper medium for elementary instruction in mathematics.

NOTES ON THE U. S. STEAM FRIGATE "MISSISSIPPI."

BY CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.
(Concluded from page 361.)

An examination of the indicator diagrams from the cylinders of the "Mississippi," shows that the pressures resulting from the expansion of the steam *after it is cut off*, are considerably greater than what they should be, calculated by Mariotte's law. This is obviously owing to the before explained causes, for I do not consider that the absorption of heat

Main deck	-	12 68	pounders, of 65 cwt.	9 ft. long.	
" "	-	14 32	"	" 56 "	9½ "
" "	-	2 32	"	" 50 "	9 "
Quarter deck	-	1 68	"	" 95 "	10 " (on pivot.)
" "	-	10 32	"	" 32 "	6½ "
Forecastle,	-	1 68	"	" 95 "	10 " (on pivot.)

The following extract from a letter to me, written by a naval engineer of high ability, now serving on board the "Mississippi," will be of general interest in this connection, showing the inferiority of paddle-wheel steam frigates to screw steam frigates:

U. S. S. "Mississippi," July 17, 1850.

"You have no doubt seen accounts of experiments made by the British government, in the application of the screw to one of their line-of-battle ships, and some other class vessels. These vessels are styled the "Experimental Steam Squadron," and fortunately happened to be in this port on our arrival; you may be sure

from the metal of the cylinder by the expanding steam, capable of sensibly influencing the result, as indeed it appears not to have done in Pambour's experiments.

I cannot better close this article than by stating, that the Mississippi joined the Mediterranean squadron in June, 1849, and up to September, 1850, had towed the flag-ship "Independence" 1,376 miles; the "Independence" having sailed only about 400 miles since joining the squadron. Now it is evident that, if a steamship is necessary to tow flag-ships about, true economy as well as convenience would be consulted by converting the flag-ship at once into a steamer. In fact the old fashioned sailing man-of-war, with its traditions of an ignorant age, is pretty much an obsolete idea, as this illustration proves, being altogether unfitted for the "modern improvements" of the times, and it will totally disappear on the first naval war. Screw steamships of war are the only vessels that could prove effective in these "latter days." To show their great superiority over even paddle-wheel steamers, contrast with the before-mentioned battery of the "Mississippi," that of H. B. M. screw steamship "Arrogant," of slightly *less* size, and with equal consumption of fuel, greater speed; now forming part of the British squadron in the Mediterranean, and carrying on her

I lost no time in visiting them. The "Houge" (line-of-battle ship,) remained but two days, and I was unable to get her dimensions, but I give you all I could learn of her. She is an old ship, with her stern altered so as to overhang, and the screw is hoisted up through it. As all the other vessels have this peculiar stern, I will briefly describe it. There are two stern posts, fore and aft, and the screw is supported in a frame setting between them; the whole system can be hoisted up at pleasure, by worms working into racks, secured to the frame and operated from the deck. At the water line, the decks, and also side planking, are extended aft to the further stern

Indicator diagrams referred to in the article on this subject in the preceding number of the Magazine.

Fig. 1.

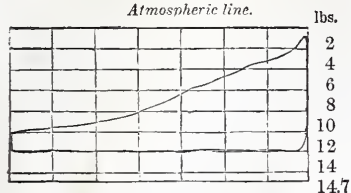
Atmospheric line.

Fig. 2.

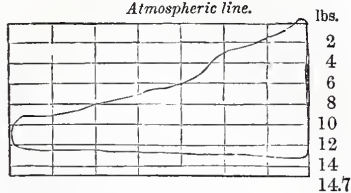
Atmospheric line.

Fig. 3.

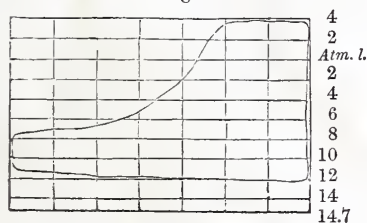


Fig. 4.

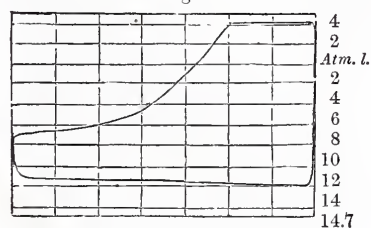


Fig. 5.

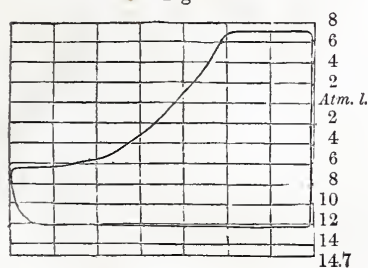


Fig. 6.

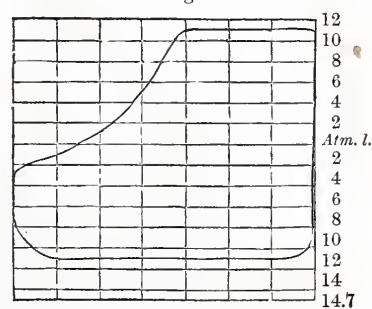


Fig. 7.

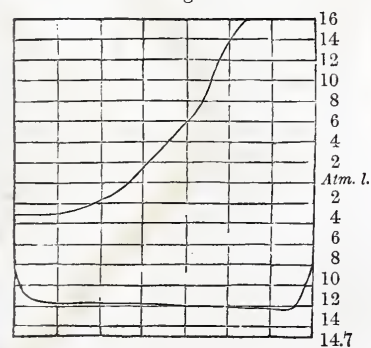
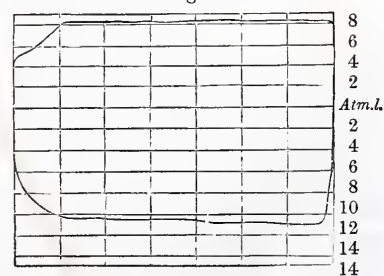


Fig. 8.



posts; through these overhanging decks an opening of sufficient size is left to allow the frame and screw to pass through. The eye in the screw to receive the shaft is square, and when it is desired to hoist the screw, the shaft is run in far enough to clear it.

The "Houge" has four direct acting engines, two upon each side of shaft. They are badly constructed as regards economy of space and frequently break down, but run well, driving the vessel 9 knots in smooth water. The "Conflict" has the same kind of engines, but the air pump and condensers are placed so as to occupy less space and give no trouble in the way of breaking down. As near as I could judge she is about the size of the "Encounter."

The "Arrogant" is a frigate, mounting 68 and 32 pounders. There is nothing about this vessel that can be altered for the better, except the boilers, which in all this squadron have the same faults; but considered as war vessels, there never was their equals, and when we wish to build a navy on proper principles, we must copy them. With their screws up, they sail as well as the best sailing ships, and as steamers they possess all the speed necessary. The engines (Penn's double trunk,) of the "Arrogant" and "Encounter" are, in my opinion, most decidedly the best adapted for screw vessels of any now in use. Were the engines of our "San Jacinto" to be worked up to as many revolutions as the "Arrogant's" are, they would shake the hull in pieces; but in these, there is so little weight in motion that not the least inconvenience is felt.

I would like to give you the arrangement of these engines, but it would require some pages and perhaps be of little use; but permit me again to say, that for the purpose there never was their equal, and this opinion has been formed after having been at least twenty times to look at them.

The screws of these vessels have but two blades, formed of the $\frac{1}{6}$ th of the screw surface, considered as a disc, consequently the opening through the deck requires but very little space, and the chief engineer assured me, that after repeated experiments which he had witnessed, they had found the two blades more efficient than any other number; and he

is a man in whom one can place confidence.

I have compiled, from the official records of the Navy Department, the following comparative view of the yearly cost of maintaining in active service a first class sailing and a first class steam frigate, taking the "Mississippi" for the exponent of the latter. The following statement exhibits it:

FIRST CLASS FRIGATE.

Total for Pay,	-	-	\$91,330 00
" " Rations,	-	-	35,113 00
" " Medicines,	-	-	1,200 00
" " Ordnance Stores, &c.	-	-	4,500 00
" " Contingencies,	-	-	6,750 00
" " Wear and tear,	-	-	30,000 00
			\$168,893 00

FIRST CLASS STEAMER.

Total for Pay,	-	-	\$61,279 33
" " Rations,	-	-	17,155 00
" " Medicines,	-	-	800 00
" " Ordnance Stores, &c.	-	-	3,000 00
" " Contingencies,	-	-	4,000 00
" " Wear and tear,	-	-	15,000 00
Fuel for 91 days (one-fourth the year) 31 tons per day, at \$7 per ton,	-	-	19,747 00
			\$120,981 33

Difference per annum in favor of steamer, \$47,911 66, or *over 28 per cent. less than* the yearly cost of the sailing frigate.

The above comparison includes fuel for the steamer on the supposition of steaming at maximum rate one fourth the time. This is as high a proportion as merchant steamers steam, and is only reached with government steam ships on extraordinary occasions. The "Missouri" (twin vessel with the Mississippi) was engaged for over a year in active cruising along the coast of the United States from Maine to Texas, visiting every accessible port, and being an unprecedented proportion of the time under steam, and yet during the whole of this period (over a year) consumed but 2,000 tons of coal, in place of the 2,821 tons of my estimate. It will therefore be seen that my estimate of fuel is in the maximum.

There is, however, another element in

the comparison not yet included. A sailing frigate will average in speed, measured on a straight line from port to port, about 4 miles per hour. A steam frigate's average measured in the same way is about 8 miles, or double. Now one-fourth the time actually cruising is a larger proportion of the time for which they are in commission than is made by sailing ships of war, and as their speed is only half that of steam frigates, it is evident equal service would be performed by the steamer actually under way one-eighth the time. With equal efficiency or equal amount of service performed, then the above cost of fuel should be reduced one-half. The item for wear and tear would also be similarly reduced. The service being performed with double dispatch is an element of great value, though impossible to estimate in dollars.

It may be argued, however, that the sailing frigate, carrying a greater number of guns, is a more effective war vessel than a similar steam frigate. This consideration disappears on examination. The weight of ordnance which a vessel can carry depends upon the size of the vessel and proportion of its scantling. Our present first class sailing frigates of 44 guns, have eight of them only 68 pounders; the balance being 32's with some 42's. This is as heavy a battery as they can support; to carry more heavy guns, the number of the smaller ones must be diminished and the vessel be made larger and stronger—in other words, must cease to be a frigate, and become a line-of-battle ship; when the comparison with the steamer, still a frigate only, would be no longer admissible. In the actual state of things, then, we find the sailing frigate carrying only eight 68 pounders, and the steam frigate "Mississippi" (inferior in that respect to the screw steam frigate "Arrogant" of somewhat less size), carrying eight 68 pounders and two 120 pounders, on pivots. As the steamer possesses all the advantages of locomotion over the sailer, she would of course fight at the proper range for her heavy guns only, in which case the sailer's 32's and 42's would be deficient in range and effect, and the combat would actually be between the eight 68's of the sailer and the eight 68's and two 120's of the steamer, the latter having the enormous advantage of taking any position deemed best, and even, in

case of finding herself overmatched, to be able to steam away from an antagonist without power to follow, making victory to the sailer, even if won, perfectly barren, and leaving the beaten steamer in a condition to pick up in retreat any enemy's vessel that may be in sight, of inferior force, under the very nose of her inert victor.

In view of the vast improvements made within the last twenty years in practical mechanics, and of the vast discoveries that have been made in the same period in chemistry and physics, and with their practical results apparent as far as they have been applied to model ordnance and propulsion of war steam vessels, our present naval system, copied *verbatim, literatim et punctuatim*, from the English one of the days of Admiral Drake and Benbow, of three or four centuries back, must be pronounced *effete*; the first naval war would leave not a vestige of it, and as the only reason for supporting a navy in peace is for the purpose of having it ready in the event of war; the necessity of keeping it up fully (if kept up at all) to the progress of the times, is obvious; and the only reason that can be given for the supineness of Congress in so important a matter, is that spirit of conservatism, which, though less strong in the United States than in other countries, has sufficient strength even here, to materially check in many things, navy especially, the progress of the "great progressive, go-ahead, democratic, American nation," as our cousins abroad call us. It is one satisfaction, however, to know that the truth will ultimately prevail, and it is better to awake even near sunset than to sleep all day.

COMBUSTION OF COAL APPLIED TO THE PURPOSES OF STEAM NAVIGATION.

BY CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.

Formation and Constitution of Coal.

The decomposition of vegetable matter under peculiar circumstances produces coal.

Coal, omitting the mineral substances which remain as ashes after its combustion, is composed, like the vegetable masses from which it is derived,

essentially of carbon, oxygen, hydrogen, and nitrogen, and upon the proportions of these elements, depends its quality.

During the decomposition of the original vegetable mass, a portion of the carbon is removed, in the form of carbonic acid, by combining with oxygen,—and a portion in the form of carburetted hydrogen by combining with hydrogen. The continuation of this process leaves carbon a more and more important constituent in the remaining mass. The gases evolved from beds of coal, are the products of this continued decomposition,—a decomposition still in progress when under favorable circumstances.

Coal, in common terms, is called bituminous, when the carbon does not exceed 75 per cent. of the mass; when the carbon amounts to 80 or 90 per cent. the coal is called anthracite, or in other words, the more advanced state of decomposition of the original vegetable mass, goes by the latter (anthracite) name.

Thus the terms bituminous and anthracite only denote a less or more advanced state of decomposition of the same original vegetable mass. The change from bituminous into anthracite coal may be produced artificially in a manner to geologically illustrate the subject.

Mean composition of coal gases, collected from eight seams in various English coal pits:—

Carburetted Hydrogen,	87.925
Nitrogen,	10.800
Oxygen,	0.450
Carbonic Acid,	1.312
Hydrogen,	0.375
	100.862

Composition of English bituminous, caking coal.

	Newcastle.	Cannel.
Carbon,	75.28	64.72
Hydrogen,	4.18	21.56
Nitrogen,	15.96	13.72
Oxygen,	4.58	0.00

Rationale of the Combustion of Coal.

The constituents of coal, which volatilize at a temperature lower than what is required for ignition, and of which hydrogen is the principal, are called Bitumen. At ordinary temperatures the hydrogen forms, with a portion of the

carbon of the coal, carburetted hydrogen in the solid state. This, by a raised temperature is volatilized, the carburetted hydrogen taking the gaseous form, and leaving the carbon which was in excess, in a solid state; this carbon will be distinguished as Fixed Carbon.

In bituminous coal, as procured from the mines, the bitumen and the fixed carbon exist in the solid state in the same mass, but their respective characters and modes of entering into combustion are different.

The first leading distinction is, that the bituminous portion is convertible to the purposes of heat *in the gaseous state only*, while the fixed carbon is combustible *in the solid state only*, and this results from the fact, that a less temperature than what is required for the ignition of fixed carbon, is sufficient to volatilize the bitumen. Thus in the combustion of coal, the bitumen is *first* disengaged in the gaseous state and *then* burnt; the fixed carbon *lastly* enters into combustion, after *all* the bitumen has been expelled from the mass; for the fixed carbon cannot be raised to a temperature higher than what is required for the volatilization of the bitumen, until all the bitumen has been volatilized; so long as any bitumen remains, the fixed carbon must continue black and utterly inoperative in generating caloric; the great proportion of caloric applied to the fuel, being absorbed and rendered latent by the volatilization of the bitumen.

Coal in its natural state when thrown upon a fire is a *cooling* medium, and absorbs instead of giving out caloric, and that to a greater degree than would result from its mass absorbing from the fire sufficient caloric to produce an equilibrium of temperature; for the caloric so absorbed volatilizes the bitumen instead of igniting the mass,—because the bitumen requires a lower temperature for its volatilization than the fixed carbon for its ignition. Now volatilization is a *cooling* or caloric absorbing process, by reason of the quantity of caloric converted from the sensible to the latent state, and this quantity of caloric is taken from the amount in the furnace, consequently reducing the temperature lower than it would be reduced by only a sufficient quantity being absorbed to bring the fresh and the ignited fuel into equilibrium.

Now the process of volatilization continues until *all* the bitumen is volatilized; until this takes place therefore, the fixed carbon remains at a temperature below ignition, and black.

The bitumen of the coal, by reason of the great proportion of hydrogen which it contains (and which is its main constituent), absorbs caloric with great avidity, the first result of which is its change from a *solid* to a *tarry viscous semifluid*, and subsequently by further addition of caloric to *gas*. The caloric so absorbed and rendered latent, is wholly lost for evaporative purposes, as the gas is not afterwards condensed, and therefore does not give out the caloric rendered latent in its generation from a solid. After the bitumen has been converted into gas, it is *then* available for heating purposes, by entering into chemical combination with oxygen. The amount of caloric expended in converting the bitumen from a solid to a gas, is a total and irrecoverable loss, as regards evaporative purposes.

Thus every charge of fresh coal, thrown into a furnace, becomes a refrigerator mechanically and chemically.

Mechanically:—In intercepting radiation by its interposition between the ignited coal on the grate and the evaporating surface of the furnace; and in dividing the caloric in the furnace among an additional mass of fresh fuel of lower temperature. This division of caloric will continue to reduce the temperature until an equilibrium is established between the fresh and ignited fuel.

	Volume.	Atoms.	Weight.		Volume.	Atoms.	Weight.
Carbon	$\frac{1}{2}$	1	6	} forming carbonic acid gas	1	1	22
unites with Oxygen	1	2	16				

It must here be plainly understood, that the carbonic acid gas is formed by, and is the result of, the chemical combination of carbon and oxygen, or in common language it is the product of combustion, and as no more than the proportion of oxygen above stated can be taken up by the carbon, no more chemical action—that is, combustion—can take place, and of course no more caloric (which is extricated by the chemical combination) can be evolved by the further addition of either of these elements. The carbonic acid gas is totally unavailable for the generation of caloric by any

Chemically:—By presenting to the caloric in the furnace a mass from which gas will be generated, and in its generation convert a portion of that caloric from the sensible to the latent state.

By the application of caloric to coal, two kinds of hydro-carbon gases are evolved, and they may be generated in the furnace at the same time; one, the carburetted hydrogen—the other, the bi-carburetted hydrogen. Now combustion decomposes these gases, and their constituents form new compounds with oxygen, the carbon forming carbonic acid gas, and the hydrogen forming water. The carburetted hydrogen gas consists of two volumes of hydrogen and one of carbon vapor,—the three volumes being condensed into the bulk of one atom of hydrogen; that is, into two-fifths of their previous aggregate bulk. The atom of bi-carburetted hydrogen gas is the same in bulk as the atom of carburetted hydrogen gas, but with an equal quantity of hydrogen it contains double the quantity of carbon.

When mixed with a sufficient quantity of oxygen and raised to a certain degree of temperature, the above gases decompose, and their carbon, separating from their hydrogen, combines with oxygen in the definite proportion of one atom (by weight 6) of carbon and two atoms (by weight 16) of oxygen, forming carbonic acid gas. The oxygen by volume being double the carbon, and by weight as 16 to 6.

known means. It is rather more than one half heavier than atmospheric air, 100 cubic inches weighing 46.50 grains. It is precisely equal in volume to the original bulk of the coal gas from whose composition it is obtained.

When oxygen is presented to the carbon in an insufficient quantity to afford two atoms to one of carbon, another gaseous compound is formed, called carbonic oxide, which consists of one atom of oxygen and one of carbon. The atom of carbonic oxide occupies the same bulk as the atom of carbonic acid, although the latter contains but half the quantity

of oxygen to the same quantity of carbon. The proportion of oxygen in carbonic oxide, not being a saturating proportion, further chemical combination will ensue upon adding more oxygen, and of course caloric will continue to be evolved,—that is, combustion will go on till the carbon has acquired its full dose of oxygen, when it will cease, and the result will be carbonic acid as before.

The most common way in which carbonic oxide is produced in the furnace, is, the air on entering from the ash-pit gives out its oxygen to the glowing fixed carbon on the grate, and evolves caloric in the formation of carbonic acid gas. This gas, passing up necessarily through the body of incandescent carbon, takes up an additional quantity of it and becomes carbonic oxide gas, and an additional supply of oxygen is necessary to consume the additional carbon so taken up, in default of which it passes away unconsumed. By the operation of taking up this additional carbon, the latent caloric required for volatilization is wholly lost for evaporative purposes, and unless a further addition of oxygen be made, this carbon, so taken up is unavailable as fuel. Thus, loss of fuel is not only sustained by the passing off of unconsumed carbon in carbonic oxide, but there is also an irrecoverable loss of caloric to the amount rendered latent in the conversion of solid carbon into carbon vapor.

Carbonic oxide gas, when mixed with

	Volume.	Atoms.	Weight.		Volume.	Atoms.	Weight.
Hydrogen	2	—2	—2	} forming vapor of water	2	—2	—18
unites with Oxygen	1	—2	—16				

It is thus found, that to saturate the one volume of carbon vapor, two volumes of oxygen are required; whereas to saturate the two volumes of hydrogen, one volume only of oxygen is required. Hence we see in the case of carbon, the *half volume* of carbon and *one volume* of oxygen become condensed into *one volume* of carbonic acid; and in the case of hydrogen, the two volumes (meaning double bulk) of hydrogen and one volume of oxygen become condensed into two volumes of steam. It is experimentally proved that one atom of hydrogen and one atom of oxygen (*the former being double the bulk of the latter*) unite in the

half its volume of oxygen, may be exploded by the electric spark. It is a very little lighter than the atmospheric air, 100 cubic inches weighing 29.65 grains.

Thus, it appears, a full measure of caloric from fuel cannot be had, unless oxygen be present in volume double that of the carbon.

Having thus disposed of the carbon constituent in the coal gases, there remains the hydrogen to be accounted for. The carbon was in weight equal to 6 parts out of 8 (the original weight of the gas), in bulk however it was but $\frac{1}{2}$ th; and when it is recollected that although the carbon has greater illuminating power than the hydrogen, yet that the hydrogen has far greater heating power than the carbon, it will be perceived how great would be the loss, should these $\frac{1}{2}$ ths of hydrogen pass off unconsumed.

It is uncertain whether the oxygen will unite first with the carbon or with the hydrogen, but if admitted only in quantity enough for one, the heating properties of the other must remain undeveloped. By chemical experiments it has been discovered that the oxygen-saturating equivalent of an atom, or any other given quantity of hydrogen, is not a *double volume*, as with carbon, but a *half volume only*,—the product being vapor of water. The relative weights of the combined volumes are 1 of hydrogen to 8 of oxygen, and the bulk when combined is condensed into $\frac{2}{3}$ ds of the aggregate bulk of both.

formation of water; and that one atom of carbon vapor and two atoms of oxygen (*the latter being double the bulk of the former*) unite in the formation of carbonic acid gas. Thus the ultimate fact of which we were in search, is, that one condensed volume of the gas, as generated from the coal, requires two volumes, or double its bulk, of oxygen; that being the quantity required for the saturation of its constituents when separated.

The quantity of oxygen required for the saturation and combustion of the two constituents of coal gas being thus ascertained, the remaining point to be investigated is the quantity of atmospheric air

required to supply this quantity of oxygen.

It is known from chemical experiments, that the proportion of oxygen in volume in atmospheric air, is $\frac{1}{3}$. Five volumes of the latter will therefore be required to furnish one volume of the former, and as *two* volumes of oxygen are required for each volume of coal gas, —and as each volume of air contains $\frac{1}{3}$ th its volume of oxygen, there are needed 10 volumes of air from which to obtain 2 volumes of oxygen.

Atmospheric air is composed of two atoms of nitrogen and one atom of oxygen. One atom of nitrogen is double the volume of one atom of oxygen, and their relative weights are as 14 to 8; the gross volume of the nitrogen in air, being thus four times that of the oxygen; and in weight as 28 to 8. The absolute weight of 100 cubic inches of atmospheric air is 305 grains.

The foregoing facts may now be recapitulated.

First.—That each volume of coal gas requires 2 volumes of oxygen.

Second.—That to obtain these 2 volumes of oxygen, 4 atoms of air must be employed.

Third.—That these 4 atoms of air are equal to 10 volumes of coal gas; each volume of the latter, in fact, requiring 10 volumes, or 10 times its bulk of air.

The bi-carburetted hydrogen requires necessarily a larger quantity of oxygen and therefore of air. The only difference here necessary to observe between the carburetted and bi-carburetted hydrogen, is that the latter contains 2 atoms of carbon instead of 1, and it follows that a proportionally additional quantity of oxygen is required for this additional atom of carbon. Hence if carburetted hydrogen requires 2 volumes of oxygen, bi-carburetted hydrogen will require 3 volumes. And so of air, if 10 volumes of air are required for the one gas, 15 volumes will consequently be required for the other gas.

method, which I have seen described—I don't know where—and which I sometimes practise. I give you a simple example of five figures in each factor,—

$$\begin{array}{r} 21,524 \\ 14,315 \end{array}$$

Ans. 308,116,060

The process being mental, these are all the figures necessary to be made.

The operation may be explained as follows:—

(First.)	(Second.)	(Third.)
$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 2,0 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 2 \\ 10 \\ 4 \\ 1,6 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 1 \\ 25 \\ 2 \\ 12 \\ 4,0 \end{array} \right.$

(Fourth.)	(Fifth.)	(Sixth.)
$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 4 \\ 5 \\ 5 \\ 6 \\ 1,6 \\ 3,6 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 3 \\ 10 \\ 1 \\ 15 \\ 8 \\ 4 \\ 4,1 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 4 \\ 2 \\ 3 \\ 20 \\ 2 \\ 3,1 \end{array} \right.$

(Seventh.)	(Eighth.)	(Ninth.)
$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 3 \\ 6 \\ 4 \\ 5 \\ 1,8 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 1 \\ 8 \\ 1 \\ 1,0 \end{array} \right.$	$\begin{array}{r} 21524 \\ 14315 \end{array} \left\{ \begin{array}{l} 1 \\ 2 \\ 3 \end{array} \right.$

1st. Multiply together the figures in *units'* place ($5 \times 4 = 20$): write down the units (0) of the result, and carry the tens (2) to the next step in the operation.

2d. Cross-multiply the figures in *units'* place by those in *tens'* place ($5 \times 2 = 10$ and $1 \times 4 = 4$); to these products add the *tens* before carried ($2 + 10 + 4 = 16$); set down the right hand figure (6) of this sum, and carry the other (1) as before.

3d. Multiply the *units* into the hundreds, and the *tens* into the *tens*. The right hand figure (0) of the sum of the products, and the number last carried ($1 + 25 + 2 + 12 = 40$), is to be written down, and the other (4) carried forward.

4th. Continue the operation in a similar manner, as indicated by the double arrows above, until the process is complete.

SHORT METHOD OF MULTIPLICATION.

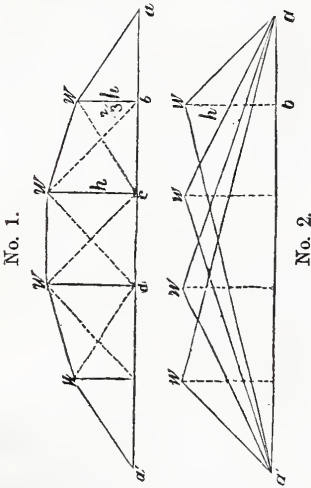
To the Editor of Appleton's Mechanics' Magazine.

SIR:—In looking over the "Short Method of Multiplication," in your June No., I was reminded of another short

Shady Side, June 7, 1851.

Extending our investigation to longer spans, of say from 40 to 80 feet, the number of bearing points for the distribution of the weight being increased in the proportion of the length, a comparison analogous to the one presented in tract No. 2, will show the most economical arrangement for the timber of such a bridge. The independent brace for each point of support, throwing their weight directly on the abutments, is found not to be so economical as the introduction of a straining piece between the heads of the verticals.

Taking the two trusses Fig. 1 and 2, of the same span and rise, and divided into



five equal spaces, giving four points of support for the load, which we will suppose to be distributed equally at the several points.

In truss Fig. 1, let $a a' = 5$ and $a b, b c$ each = 1. Let $w c = h$ and $w b = \frac{2}{3} h$. The points $a w w w w a'$ may be considered as points in a circular arch, and in equilibrium under the weights $w w w w$.

The horizontal thrust on the tie produced by the weights $w w$ &c. is $= \frac{3 w}{h}$.

For as already shown the action of tension in this case, will be represented by

$$\frac{a b}{\frac{2}{3} h} w + \frac{a b}{\frac{2}{3} h} w = \frac{2 w}{\frac{2}{3} h} = \frac{3 w}{h}.$$

In the case of the independent braces, Fig. 2 being an equal space and rise, $a a'$ and h , and loaded with the same weight at the point, $w w$ &c. Each pair of braces will exert a certain thrust, and the tension on the tie will be expressed by the sum of the several thrusts produced by all the weights, (for these several

thrusts, see tract No. 1), or $\frac{4}{3} \frac{w}{h} + \frac{2}{3} \frac{2 w}{h} + \frac{2}{3} \frac{3 w}{h} + \frac{4}{3} \frac{w}{h} = \frac{4 w}{h}$ is the tension

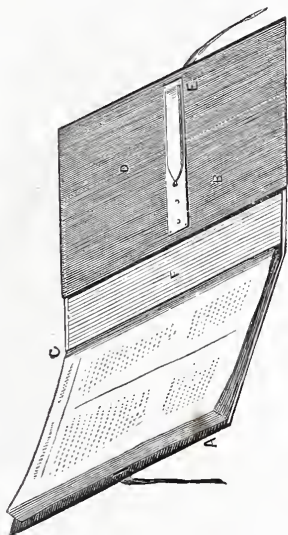
on the tie, which is $\frac{1}{3}$ greater than in Fig. 1, hence this latter form of truss would require more timber than that of Fig. 1, to bear the same load; and attended with the inconvenience of the long braces which would not bear the thrust communicated to them as advantageously, as the shorter pieces in Fig. 1; but on the other hand the condition of equilibrium may be disregarded, as the weight may be removed from any of the braces without destroying the stability of the structure, whereas in Fig. 1 to remove the weight from either of the points w , would destroy the equilibrium and the truss would yield at once; to prevent this a system of bracing is introduced between the verticals (on the dotted lines), making the whole amount of timber about the same, probably, as in Fig. 2.

It will be seen by reference to Tract No. 2, that the same advantages obtain in this case by the use of short braces, as in the case there discussed; the comparisons are analogous, and as in that, the truss with diagonal braces between the verticals, is preferable to that in which independent pairs of braces sustain the points at which the weight is applied, although the latter, as before remarked, is less liable to change of shape by a variable load; the practical inconveniences attending the construction of this form of truss, however, render it every way inferior to the other for long spans.

PAMPHLET-BINDER.

This is one of the best of the numerous contrivances of this class which we have seen. Our engraving represents the "holder as open, with some numbers of a pamphlet, or sheets of music placed

in it. It consists of two neat cloth-boards, *A* and *B*, to the former of which is attached a junction-piece of leather at *C*, answering the office of the leather binding of a book. This junction-piece is passed into the recess between the back and front portions of the double board, *B*, up which it extends, as indicated by the dotted line, *D*. A small notch is cut in the inner board at *E*, and through this a leather strap, attached to the edge of the sliding junction-piece, is passed, and having a hook at its extremity, it is capable of being fixed at any point in a piece of brass perforated with a row



of small holes. The junction-piece, or central back, has a series of attaching ribbons attached at each end, side by side, for holding the papers or sheets. Thus, as each sheet is inserted under its retaining ribbon, the sliding junction-piece is drawn out further from its recess in the double back, *B*, and secured from slipping in either direction by the hooked strap already described.

THE RACE OF ATLANTIC STEAMERS.

We extract the following from the *London Artizan*:

The following article, copied from the *New-York Tribune*, gives an ingenious explanation of the causes of the imper-

fect success of the American ocean steamers; the only objection to the explanation being, that it is based upon an error which, when corrected, leaves the writer nothing for his hypothesis to rest upon. It is to be regretted that so much algebra, and so many graceful remarks, should be wasted on an assumption which turns out to be a fallacy; but our readers will not be the less edified by the specimen of ingenious reasoning, which we here present for their exercitation:

First of all, it will be to the purpose to compare the dimensions of the *Baltic* and one of the Cunard steamers (the *Asia*), as they are laid down in the draughts published by Currier, 132 Nassau-street:

	Baltic.	Asia.
Length on deck, . . .	282½ feet	280 feet
Breadth of beam, . . .	45 "	38 "
Across paddles, . . .	75½ "	67 "
Depth of hold, . . .	32¼ "	27 "
Diameter of wheels, . .	36 "	36 "
Burden, ...	2723 tons	2226 tons
Horse power, 2 engines, 1100 each	400 each	

Every one will be struck by the fact, that there being between the two rival steamers so moderate a difference in dimensions there should be so great a difference in the horse power (not less than 2200 to 800). This circumstance would have led many to anticipate that the *Baltic* would not fail to beat the *Asia* by many days in crossing the ocean. If a mathematician had dared to foretell that, on the contrary, the *Baltic* would scarcely equal the *Asia* in velocity, both he and his theory would have been laughed at. Generally, however, Experience herself takes care to revenge the honor of her learned daughter and guide, Theory; and such has been the case on this occasion. Let us seek for the reasons.

We must first bring to our recollection that, other things being equal, the quantity of power necessary to obtain a given velocity in a fluid is proportional, not simply to the velocity itself, but to its cube. A double velocity requires an 8 times greater power; a triple velocity, a power 27 times greater. Were the immersed amidship sections of the *Baltic* and *Asia* equal, and their machinery equally perfect, the former would yet have no greater speed than 15½ miles per hour, when the *Asia* would have 11. But as both are nearly of the same length,

the *Baltic*, whose burden is greater, must have a breadth and depth of immersion absolutely and relatively greater than the other; but the depth which would singly answer to the weight of the hull and of the useful burden is very much increased by the weight of the engines and coal. As a steam engine cannot consume less than 5 lb. of coal per horse an hour, the *Baltic* must consume in a single hour not less than 11,000 lbs. of coal; and, whereas the rules of the most ordinary prudence must require her always to take in a store of fuel for 15 days at last, it makes the vast load of 1800 tons of coal. How much is the weight of the engines I do not know, but it is certainly enormous; from indications privately obtained, I should judge it is not inferior to the whole weight of the coal. Consequently, a very considerable part, perhaps more than a half, of the whole power of the engines is employed in nothing else but in carrying themselves and their supply of fuel.

Be this as it may, the breadth of the two steamers we are comparing being respectively 45 and 38, and the depths of hold $32\frac{1}{2}$ and 27, if we subtract about 12 feet as an allowance for the necessary elevation of the upper deck above the water, and add something to the depth of the *Baltic* for the necessarily greater thickness of the bottom, we may well suppose that the height and width of the immersed midship sections of both steamers are respectively 45 by 24 and 38 by 17; therefore the resistance of the sea to the steamer's progress, the velocities being equal, would be nearly in the ratio of 1080 : 646. Consequently, to obtain the same speed, the force of the *Asia* being 800 horses, that of the *Baltic* should be proportionately to the sections, 1337; but it is 2200; then, were steam applied to equal advantage in both ships, their respective velocity would be in the ratio of the cubic roots of 1337 and 2200, which are nearly 5.113 and 6.037. That is to say, if the average passage of the *Asia* be reckoned at 12 days, that of the *Baltic* should be only 10. Now, this is not the case. In good weather, of course, she will have shorter average passages than the two last, but the *Asia* also will then make shorter voyages. There must be, therefore, a reason why the *Baltic* and her fellow-steamers of the American line

cannot have that full advantage of nearly two days which belongs to the proportion of their steam power to their resistant transverse sections.

The main reason lies in the comparative smallness of the paddle wheels. To prove this, I am obliged to demonstrate a general theorem—namely, that the larger the working surface of the paddles the greater the vessel's velocity must be, the quantity of steam employed being the same. Let A be the reduced surface of the paddles, by which I mean the hypothetical surface of a single paddle, which, beating perpendicularly the water with the velocity proper to the actual inferior paddle, would give an effect equivalent to the joint effect of the several paddles partially or totally immersed with different inclinations.

The pressure which this reduced surface exercises backward against the water by its revolutions is in the compound ratio of A itself, and of the square of its absolute negative or backward velocity, a velocity which we shall call u , as we call v the steamer's velocity. Let b, c, d, e , &c., be constant coefficients. The resistance of the sea to the advance of the steamer is proportional to the square v of her velocity. By the fundamental principles of dynamics, when v is uniform, this resistance must be equal to the pressure exercised by water in the contrary direction against the paddles by virtue of their backward motion; we shall have, therefore, $v^2 = bA u^2$.

Here it appears that we may augment the ship's velocity V either by increasing A or u ; we could do both were the power of the engines indefinite; such not being the case, we cannot augment either of the quantities, A, u , without diminishing the other. Now, by augmenting A , we have an advantage much superior to the disadvantage arising from the obliged diminution of u . Let us call C the quantity of steam constantly expended by the engines in an unit of time; this quantity is in the composed ratio of the density of steam in the cylinders, and of the number of strokes in the unit of time. But the density of the steam is proportional to the pressure upon the surface of the pistons, and this pressure must be in a constant ratio with the pressure $A u^2$ of the paddles moved by the pistons; and the number of strokes of the latter in the

unit of time, being equal to twice the number of revolutions of the paddles must also be proportional to the velocity of the revolutions of the paddles, which is $u+v$. Therefore, $C = d A u^2 (u+v)$.

If the value of A , taken from this equation, be substituted in the former, we shall have

$$v = \frac{d C}{u + v}$$

Here it is visible that a and C being constant quantities, the smaller u is, the greater will v be—namely, to have the greatest speed of the steamer we must give to the backward motion of the paddles the least possible velocity. It appears, however, from the second equation, that we cannot decrease u without increasing A ; to wit, we must supply by an augmentation of the surface of the paddles their diminished velocity.

To translate mathematical demonstrations into language intelligible to all, and still absolutely conclusive, is not an easy task. I may, nevertheless, entreat those of my readers who may happen to be little conversant with algebraical calculations to represent to themselves, in the room of the actual paddles of the *Baltic*, two other paddle wheels of the same diameter, but wider, and therefore with larger blades than the present ones. To find an equal backward resistance in the water, the new paddles, on account of the great surface, do not want so great a velocity as the former. Now, as the pressure exercised, either by the new or old paddles, is by supposition the same, the required tension or density of steam by the cylinders will also be the same in either case. As, however, the new paddles revolve more slowly than the old ones, the pistons also will make in a given time a less number of strokes, and the vessel consume less steam and coal. So with wider paddles the *Baltic* could consume less coal than she does, and still go at the same velocity. This being once granted, it will then be easily admitted, too, that if the *Baltic* should employ with the new wider paddles the same quantity of coal she would necessarily acquire a greater speed. It will also be easily understood, that instead of making the paddles simply larger in width, there will be an advantage in making them longer also,

and increasing proportionably the diameter of the wheels.

With the mass of people the best and most abstract reasoning has seldom any practical effect unless it is supported by some obvious fact. Fortunately there is a capital fact at hand. Let us look again at the dimensions of the *Baltic* and *Asia*. The breadth of beam of the former is 45 feet, and across paddles $75\frac{1}{2}$. This shows the paddle wheels to be of the joint breadth of $30\frac{1}{2}$ feet, or $15\frac{1}{4}$ each. A like calculation for the *Asia* will show her paddles to have a breadth of $14\frac{1}{2}$ feet each; only nine inches less than the former. The diameter of wheels in both cases is exactly the same, 36 feet. It may then be said that the paddles of both steamers are very nearly equal. So it is with the other steamers of the Collins' line. Is not this a singular fact? The power setting the *Asia* in motion is 800, the power working the others is 2,200, and still the organ of locomotion is the same. Either the dimensions of the *Baltic* or of the *Asia* are wrong. Theory unhesitatingly would have settled the question in favor of the *Asia*, even before seeing both at work. Practical men would not decide so promptly. But here is the fact that the *Asia*, capable of carrying a cargo little short of that of the *Baltic*, and with only 800 horses, is faster than the latter with 2,200 horses. I hope, then, that even mere business men will readily acknowledge that of the two it is the *Baltic* which has paddle wheels of improper dimensions.

It is to be desired that they should be removed for larger ones. How much larger? The larger the better; but let them bear to the moving power at least the same relation as in the *Asia*. To make them so, they should have a radius of 30 feet instead of 18, as they now have.

This, of course, would require other alterations. If the engines are capable of safely enduring a greater pressure in the ratio of the increased length of the time of a revolution of the wheels—which I think very likely to be the case—the cylinders need not be changed; if not, others might be made whose capacity shall bear to the capacity of the present cylinders the same ratio as the time of revolution of the new wheels to that of the old ones. The increasing of

the diameter of the wheels, besides the corresponding augmentation of surface in the paddles, will have another advantage, by partially obviating an inconvenience of which I have not yet spoken. It is known that a considerable part of the effort necessary to move the paddles immersed in water is lost because of the obliquity of their action through the greater part of their movement in the water. How much this defect is compensated by having a greater number of paddles depends upon the degree of immersion. Now, as the great consumption of coal must cause the waterline to vary considerably during the voyage, if the arc of immersion of the paddles be the best possible at any one time, it must be very unfavorable either at the beginning or towards the close of the voyage; and this cause is also a drawback in the useful effect of the power employed. This inconvenience, however, must be much less sensible in the British than in the American steamers, as the load of coal in the former is in proportion very considerably smaller; but it will also be reduced in the American steamers by the simple enlargement of the diameter of the wheels. It would be reduced to a much more considerable extent by making the axle capable of being raised or lowered upon screws with a corresponding extensibility in the connecting rods. Such a correction, which is wanted nowhere to so great a degree as in the American Transatlantic steamers, if adopted by them, would indirectly benefit future steamers even not adopting it, by furnishing the easiest and surest manner of testing by experience what is practically the best arc of immersion for paddle wheels.

I am very greatly mistaken if, by such simple and easy improvements, these magnificent and powerful specimens of modern art would not gain the end for which immense sums have been and are so liberally expended upon them—that of bringing two worlds nearer to each other, not only by a few hours, but by whole days. At any rate, let the candid exposition of my opinion not be considered as a presumptuous obtrusion, but a token of the deep interest I have, with millions of other people, in the subject.

Now the main objection to all this is, that the *Baltic*, instead of being three times the power of the *Asia*, and there-

fore requiring three times the hold of the water, is only 14 horses' nominal power more! and therefore wheels of about the same dimensions ought to be equally snitable for the two vessels. The principal dimensions of the machinery of the most recent Atlantic steamers is as follows:

	Diameter of Cylinder.	Length of Stroke.	Nominal Horse Power.
<i>Atlantic</i> and <i>Pacific</i> }	95 inches	9 feet	798
<i>Arctic</i> and <i>Baltic</i> }	95 "	10 "	828
<i>Asia</i> and <i>Africa</i> }	96 "	9 "	814

We are not aware of the exact average pressures, and speeds of piston, in the respective vessels; although, no doubt, the American engines have the advantage, to some extent, of the English ones.

The American writer is quite right in asserting, that it is desirable to have as little slip of the paddle wheels as possible. He is also right in saying, that to enlarge the area of the paddle floats, if they were of insufficient dimensions, would save fuel; but if he supposes that either an enlargement of the float boards, or an increase in the diameter of the wheels would increase the speed of the vessel, supposing the engines to be fully supplied with steam, he would be disappointed. To increase the diameter of the wheels would be to diminish the speed of the vessel instead of increasing it, for the resistance of the immersed paddles will always balance the pressure on the piston; and the longer the paddle arm is the greater will be the leverage acting against the crank, and the less the resistance necessary to balance the piston pressure; so that with a large wheel there will be but a small pressure on the paddle float, and consequently but a small pressure urging the vessel forward. The receipt of this American writer, therefore, would, if carried into practice, make the vessels go worse, instead of enabling them to go better. If, as the writer asserts, the *Baltic* is a larger and heavier ship than the *Asia*; and if, as the fact appears to be, she is only of slightly greater power, it is not difficult to understand why she should fail to manifest any decided superiority over her English rivals. Power is what is wanted, not larger wheels; and these American vessels must fail in reaching any high measure of success until

the deficient power due to their larger proportionate dimensions has been supplied. With respect to his proposal to have the means of altering the immersion of the wheels, in order to compensate for the variation of draft consequent on the large consumption of fuel, such a scheme would, we fear, furnish rather too exciting an employment for the engineers in an Atlantic storm. If the Americans have not lost their natural acuteness, they will wait to see how the feathering wheels of the new 800 horse West India boats answer before they try any more experiments on their own.

We also extract the following from a letter from an esteemed correspondent:

"The writer having discovered by algebra a 'mare's nest,' proceeds very properly to vulgarize the discovery for the benefit of the unlearned. He supposes that floots of greater area of board are substituted in any steamer for smaller ones, which it may have had formerly; and then says, that forasmuch as the large boards will not require the same velocity of slip in order to propel the vessel as the small ones, and as the 'resistance' to the boards is in both cases the same, therefore the *steam* will be equally *dense* in the cylinders of the engines; and as the latter must move quicker with the small boards on account of their increased slip, so much more steam and fuel will be required, &c., forgetting that the resistance of the small boards is only equal to that of the large ones, *because* their slip is more, and therefore the same *quantity of steam* will be required (expansion not being considered) in both cases, the steam being more attenuated in proportion as the velocity of piston is greater with the small boards. *Had the matter been shrouded in algebra, query, would the Artizan so quickly discover the great error?*"—*London Artizan*.

REPORT ON THE BOILER EXPLOSION IN MANCHESTER.

BY W. FAIRBAIRN, ESQ., C. E.

The boiler in question was twenty-one feet six inches long, six feet two inches diameter, composed of plates 5-16ths of an inch thick. It had a flue of the same thickness of plates, two feet three inches diameter, which passed through it from

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one end to the other. It was six inches clear of the bottom, and the boiler had two diagonal stays, one and three-quarter inches square, flattened at the ends, and riveted to the top of the flue. The other extremities of the stays were attached to the flat ends (composed of $\frac{3}{8}$ plates) by a round pin which passed through two pieces of angle iron. The ends of the stays riveted to the flue were flattened to receive the rivets, leaving a very small portion of metal between the edge of the holes and the ends, to resist any severe strain, in the event of the accumulation of high-pressure steam in the boiler. The boiler in itself was not, however, excepting the limited number of stays to the ends, and the defective construction of the two which were attached to the flue, a weak boiler. I have computed its bursting pressure—(assuming the flue to be covered with water)—at 140 pounds on the square inch, and provided the ends had been properly stayed, it would have sustained a pressure of 276 pounds to the square inch, before explosion ensued. The cause of the accident did not, however, in my opinion, arise so much from defective construction, as from gross mismanagement, and ignorance of the inevitable consequences which must eventually arise from the conditions in which the boiler was placed.

On a careful examination of the flue and the lower parts of the boiler, there was every indication of a deficiency of water, and that a considerable portion of the upper part of the flue and the sides had been red hot. The fire must have been under the boiler from the time the engine stopped till the explosion took place; and there being no escape for the steam, excepting only a defective safety-valve (which I shall notice immediately), the result was a gradual increase of pressure—and that, probably, without the most distant suspicion on the part of an ignorant engineer that the boiler was in a dangerous state. The boiler was capable of generating a sufficient quantity of steam for a 25-horse engine; and the safety valve—of which there was only one, three inches diameter—was of a most improper and defective construction, and bad as it was, I believe prior to the explosion it was as inoperative as it is now. At the time the engine was stopped, we are not informed as to the height of water

in the boiler, nor the state of the fire underneath, whether or not it was replenished with fuel; nor have we any knowledge of the actual state of the valves, apparatus, &c., antecedent to the accident. To all these conditions we are left to draw such inferences as the nature of the case will admit. I am informed that the steam was seen to issue from the safety-valve a few minutes prior to the explosion. I have some doubts as to the accuracy of that statement, as I found the valve-spindle, two days after, firmly rusted, in the hole of the cover, and the valve, in this condition, could not therefore indicate any change of pressure during the time the engine was standing.

Taking all the circumstances into consideration, I have no doubts in my own mind as to the cause of this melancholy occurrence. I firmly believe the boiler was short of water, every outlet closed, the safety-valve, such as it was, probably fast in the cap of the spindle-box; the flue and upper portion of the sides of the boiler red hot, and, to add still more to the alarming condition of the ruptured vessel, probably a rush of water was poured upon the heated plates, causing a surcharge of highly elastic steam to combine with that already generated, until the balance of the resisting powers of the material were overcome and explosion ensued. Under such a state of things, the fearful results of the explosion are not to be wondered at. The scarcity of water, and the consequent heated state of the plates, greatly weakened the material,—and the highly elastic force of the steam was then quite sufficient to tear off the stays from the centre flue,* and the large flat surface of the ends being thus exposed, to rip up the angle iron and riveting round the circumference of those parts. The expansive force of the steam, acting in both directions, would project the boiler from its seat in the direction of Riga-street, and the opposite end, with part of the flue—separated by the concussion—in the direction of Hanover-street. Rupture having once occurred, the work of destruction was soon completed, and the projected parts, hav-

ing the force of discharged rockets, went through the factories on both sides, sweeping along with them the walls and floors of buildings where the people were employed; and thus, in a few seconds, the whole establishment was in ruins. In my opinion these events have occurred from the want of a few necessary precautions, which, if carefully followed, would save a number of valuable lives, and the property of those more immediately concerned. It will not be necessary to multiply examples of this kind, as we already have too many on record, to guard us against mismanagement, and imperfect construction.

Similar accidents have originated from similar causes, and as they may be prevented or greatly diminished, I am sure the jury will not consider me intrusive if I venture to offer a few suggestions, which, if acted upon, would tend to mitigate, if not almost entirely remove, the evil. In the discussion of this subject, it is not my intention to create difficulties or discourage improvements in the use and application of high-pressure steam. On the contrary, I would give every possible facility for its introduction. I am thoroughly convinced of its superiority and economy, and equally convinced of the practicability of its perfectly safe application under the direction of skilful practitioners and managers of acknowledged ability.

The number of accidents that have occurred, and the *number of times I have been called upon to investigate them*, have more and more convinced me of the steps we are making in advance, and I see no more difficulty in working steam of 50 or 100 lbs. on the square inch, than at 5 lbs., provided we use properly-constructed vessels, and the necessary precautions for its retention and application. At railway stations, we do not hesitate to come in close contact with a locomotive that is hissing off steam at a pressure of 90 lbs. to 100 lbs. on the inch; and, conscious of security, I cannot conceive why we are unable to inspire the same confidence in the use of the same element in our manufacturing industry. I am perfectly satisfied it can be done, and I would avail myself of the present opportunity of stating the way in which I consider it may be accomplished. It is now eight years since

* These stays were greatly weakened by flattening their ends to receive the rivets.

the double flue boiler, with internal furnaces and alternate firing, was introduced; and although a number of modifications have since been made, I am not aware that any of them are preferable to the simple construction of the two flues, which, from my own experience, and their almost universal adoption, are the best calculated to meet the requirements of economy and safety in every department of manufacture where steam is employed as a source of power. For steam navigation and for locomotion the saving of space becomes a desideratum, but in stationary engines, simplicity of form, strength, and security in construction, as well as economy in working, are the principal objects to be attained. In the construction of boilers of the strongest form, it must, however, be borne in mind that no form or construction, however perfect, will resist an undue pressure of steam. Enlarged and free-working safety-valves, good and efficient feed apparatus, as well as careful management, are the principal essentials for security; and on these matters I have, in conclusion, to recommend attendance to a few simple rules, which, if carefully observed, will lead to the best and most satisfactory results. To construct stationary boilers as near as possible of maximum strength, I would observe that they should on every occasion be of the cylindrical form, and where flat ends are convenient, they should be composed of plates *one-half thicker* than those which form the circumference of the boiler. The flues—two in number—to be of the same thickness as the exterior shell, and the flat ends to be carefully stayed with *gussets*, or triangular plates and angle iron, firmly connecting them with the circumference, or outer shell of the boiler, as shown in the annexed sectional drawing of that part. The use of gussets I earnestly recommend, as being infinitely superior and more certain in their action and retaining powers than stay rods. They are part and parcel of the construction, and may be safely relied on as essential to the security of the boiler, and that more particularly in retaining the ends in shape, and imparting to those parts an equality of strength. These gusset plates should be placed in lines converging to the centre of the boiler, and made as long as the position

of the flues and other arrangements will admit. In submitting the above for consideration, it is not intended to interfere with measures which the legislature or local authorities of any particular district may choose to adopt for the greater security of the public. I propose it as one step in advance, and shall be glad to find its adoption general and useful.

It now only remains to direct attention to the following suggestions, which I consider essential for the protection of the lives and property of the public:—

- 1st. Boilers should not, on any account, be placed under buildings where people are employed.
- 2nd. Every boiler should be constructed of sufficient strength to resist not less than five or six times its working pressure, and every boiler should be proved by hydraulic presses to double its intended working pressure.
- 3rd. Every boiler should have two safety valves, collectively equal to one and a half times the area of the steam pipe, or the computed generative power of the boiler; one of these valves to be under lock and key, and so arranged as to render it impossible to increase or diminish its load.
- 4th. The proprietor or some authorized person to inspect the state of the boiler and valves once a month, every time the boiler is cleaned, and to record the same in a book to be kept for that purpose. For the last sixty years this has been the custom in Cornwall, where steam of high elastic force is in general use. All the engines and boilers of that district are under the control and supervision of competent persons. Monthly returns are given of the duty performed by each engine, the quantity of fuel consumed, and by constant care and attention to the state of the boilers and machinery, a great saving is effected, and accidents such as boiler explosions seldom, if ever, occur. It is not for me to give an opinion as to whether inspectors should be appointed by government or the local authorities; I only mention the fact that I consider such appointment imperative, in order to insure greater security to the public. Lastly—careful management and attention to the feeding apparatus, and all the requisite water and mercurial gauges, indicators of pressure, &c., which, being carefully registered and recorded, will lead to the best results.

We copy from the London Mechanics' Magazine some strictures on American philosophers :—

SIR,—The go-a-head, energetic spirit of the American people appears to pervade and animate even their intellectual pursuits; but unfortunately, in this case, it is neither so appropriately employed, nor is it, nor can it be, so successful in its achievements as when engaged in encountering natural obstacles and material difficulties. Their bold speculations are pushed too far in advance of legitimate induction, to bear any better character than random guesses, and the brilliant scientific discoveries which are so often blazoned rather than announced, seldom stand the test of the now severe and cautious method of European investigation.

Time will show whether there is any thing new and valuable in the means Mr. Paine employs in decomposing water by electricity, or rather, as I suppose I ought to express myself in accordance with the new ideas—in converting water into hydrogen gas; but it requires neither time nor hesitation in coming to the conclusion, that the luminous quality of the hydrogen gas, in consequence of passing it through camphene or turpentine, is susceptible of an easy common-sense explanation, without resorting to the occult catalyzing agency to which Mr. Paine, Dr. Foster, and others attribute it.

Mr. Paine says that the gas is not carbonized, and that there is no loss of turpentine. The first assertion may possibly be true, but the second was contradicted by experimenters at his own house, who found a loss of a teaspoonful of turpentine—quite a rule of thumb mode of experimenting, by the way—but which they good-naturedly attribute to evaporation and turning it from one vessel into another. Now it is well known, that although hydrogen gas when inflamed emits very few rays of light, it is not necessary that it should, in a chemical point of view, be carburetted in order to become luminous. A very minute quantity of solid matter imparted to it, such for example as may be given to it simply by passing it along a dirty metallic tube, will enable it to afford very considerable light. A small quantity of turpentine

vapor would impart sufficient solid carbon to exhibit an immense quantity of light.

It is amusing to observe that the Editor of the "Scientific American" has, according to his own statement, "never heard a single hint relative to hydrogen being a metal." Dr. Foster, however, being better informed, ascribes the luminosity to the "metal vapor" of hydrogen, and considers it analogous to the "carbon vapor of the candle or lamp." Why then imagine that "the camphene so catalyzes the hydrogen as to superinduce the development of its metallic energies," unless we are to consider that carbon-vapor is also similarly catalyzed? If so, or if indeed there exists an anomaly, and only hydrogen requires this catalyzing action, what does this mysterious process amount to?—what does it really mean? It must consist in the condensation or precipitation of the gas into exceedingly minute but palpable particles, which it is well known is the phenomenon that takes place in the case of carbon-vapor; the incandescence of these palpable particles being the source of light. It follows, then, that as we can collect soot in the one case, we ought to be able to collect solid hydrogen in the other—a discovery which would indeed immortalize American science. The college where the theory is stated to have been first promulgated should, in all justice, be the scene of the experiment.

If it be said, in reply, that carbon-vapor, so called, is in reality carbon-gas, and that its light-giving power, together with that of hydrogen gas—when catalyzed be it remembered—is not the result of incandescent particles, but of the superinduced development of metallic energies, caused by catalysis—I can only say that an explanation offered in regard to real ignorance, which amounts only to scientifically worded ignorance, is unacceptable even when it is *not* known to be in opposition to experimental conclusions. I earnestly hope, that however much it may be opposed to received opinions, the greater quantity of hydrogen gas alleged to be produced from a given quantity of electricity, will prove to be better founded on fact than the illuminating quality imparted to it, is founded on the theory assigned for its explanation.

There is another American discovery—and theory also—which at present claims, or rather clamors for attention, and that is Mr. Frost's "Stame." To vulgar minds it appears under the character of dry steam and heated steam, just as we think and talk of dry air and heated air. Others have called it "anhydrous steam," which sounds a little more scientific; whether it be correct or not I will not now stay to discuss. But Mr. Frost soars high in the regions of philosophy and discovery, and commands us to to call it "Stame;" and undoubtedly as the discoverer of a new substance, he is entitled to call it by whatever name he chooses to select,—and "stame" it shall be when he is pleased to prove to us that it is any thing more than heated steam.

"The discovery claimed," says Mr. Frost, "is, that a trivial addition of heat to steam out of contact with water, constitutes it a distinct elementary compound of the same atoms, of enormously augmented volume and value." What the value is as distinct from the volume I cannot imagine, except it be a money value; and truly this *may* be a discovery, and assuredly it is a very commendable quality in a new-found substance, although commercial rather than chemical, I opine. It is a comfort, however, to a speculative philosopher to know, that whatever may betide a favorite theory, it is at least *worth* something somewhere. It may be all wrong in a scientific, uninteresting point of view, and yet without the precincts of Academic groves, the opinions of more deeply instructed men may be pronounced in the highly significant expression—"It's all right;" for in this masonic phrase with its accompanying symbol, is embodied the profound arcana of transcendental knowledge. Professor Renwick is a mere *ignoramus* in the eyes of Mr. Frost; he has not been initiated. poor man, into this peculiar lore, by which even a neophyte in its mysteries is enabled to *calculate* the value—the *sterling* value—of a new theory, of a new substance, of a new word, in a manner more astute and knowing than any calculus with which mathematicians are acquainted would give them the means to rival.

I would not have indulged in this style of remark if it had not been for the exceedingly offensive and boasting tone of

Mr. Frost's lucubrations. Even Dr. Haycraft is assailed with coarse and abusive imputations in return for his far too laudatory notice of Mr. Frost's experiments.

That a new body, "a distinct *element*," as Mr. Frost calls it, is formed when no new properties are imparted to it—that a "distinct elementary compound is constituted," as he phrases it in another place, by simply raising the temperature of a substance, without producing any other than the usual result of increased volume or tension,—is an idea so truly ludicrous, that no notice need have been taken of it, had it not been connected with certain experiments to which a slight degree of importance has been attached, by their having been made the subject of a report of a Committee of Arts and Sciences of the American Institute, of which Professor Renwick appears to have been the chairman and the reporter. These experiments ought to have been much more closely investigated by the Committee than they appear to have been, before giving their sanction, even qualified as it is, to the results they announce. A much better experimenter and observer than Mr. Frost must confirm them before they will be received. Professor Renwick appears to have overlooked the fact, that Sir Humphrey Davy both confirmed and extended the experiments of Gay Lussac on this subject.

With regard to the confirmation of Mr. Frost's discoveries in a practical point of view, as to the economic value of heated steam, and as tested by the experimental working of a steam engine, it is worthy of remark, that instead of countenancing his preposterously exaggerated estimate of their worth, the Committee merely observed, that there existed "a very marked and decided superiority in the measure of work performed by the engine, when the steam was heated after being generated." This of course was to be expected, and has long been known and acted upon too, although from the practical difficulties connected with the matter it has not received perhaps the full attention it deserves. It is sufficiently explained upon the common-sense principle of converting wasteful watery steam into dry steam, and of slightly increasing its tension by increased temperature. Mr. Frost happily appends something more definite in his supplementary re-

marks, for he gives us data in respect to the working of a steam engine, by which we can judge for ourselves as to the amount of advantage gained by heating the steam.

The extraordinary augmentation in the tension of really *dry* steam, heated out of contact with water, alleged by Mr. Frost to be produced by slight increments of temperature, would in truth amount to the discovery of a new power in steam, and be of the utmost importance, however worthless the theory by which it is his pleasure to explain it. Having, therefore, in a former communication disposed of the phantasy of a new substance to be called "stame," let us now examine the facts upon which he rests his supposed discovery. I do not refer to his experiments with steam in glass tubes, for so carelessly were they conducted, and their results are so opposed to analogy and all former experiments, that they do not deserve a moment's attention; but in regard to the facts elicited in the actual working of a steam-engine, authenticated as they are by respectable and intelligent persons, it is perhaps worth while to notice them.

It will be proper to give the statement of these experiments in Mr. Frost's own words:—

Further Experiments.

This is to certify that we, the undersigned, met together, and witnessed the following experiments:—

First, an engine working under ordinary circumstances, with a pressure of 21 lbs. on boiler, engine made 2000 revolutions; the steam passing through a surface condenser in a cistern, heated the water therein from 48° to 62°, and engine exhausted the steam on boiler.

Under the second experiment, by heating the steam apart from water, the engine ran 2000 revolutions, and the steam condensing in the surface condenser, heated the water in cistern from 61° to 70°, and the pressure of steam on boiler increased from 21 lbs. to 37 lbs.

T. H. SECOR, Secor Iron Works, New York.

ALEX. H. STEVENS, Principal, New York University.

W. CALDWELL, Engineer, Steamers *America* and *Asia*.

EDMUND TUTHIL, Engineer, Secor Iron Works.

JOHN LEITCH, Captain, Steamer *America*.

JAMES HOW, Union White Lead Works, Brooklyn.

WM. ARTHUR, Vulcan Steam Works, Brooklyn.

The condenser fitted with mercurial gauge showed a steady vacuum of 12 lbs., therefore the effective steam power being 12 lbs. in first experiment, and $12 + 37 = 49$ lbs. in second experiment, while 14° of heat was expended in the first, and only 9° of heat in second.

Then, as

$$12:49::1:4.1 \times \frac{14}{9} = \frac{57.4}{9} = 6.36$$

times the effective force derived from an equivalent of caloric from heated steam (or stame) than was derived therefrom when applied to steam.

In this calculation it is to be observed, Mr. Frost employs the two ratios of 12 to 49, and of 9 to 14, or the single ratios of 1 to 6.36, to represent the greater amount of work done with a given quantity of caloric by his method of using it, the separate ratios having reference to the comparative states of the boiler and the condenser. Now let it pass, although it is an egregious error, that the first ratio in terms of the pressure of the steam in the boiler, correctly expresses the expenditure of heat in the respective experiments; for it cannot be denied, that if the fire be equally maintained, and heat saved, it must accumulate in the boiler. Let it be admitted, also, that the different degrees of temperature communicated to the water in the condenser as indicated by the second ratio is another criterion of the saving of heat. To ascertain this point, it is obvious that we may institute inquiries, either as to the respective quantities of caloric abstracted from the boiler, or as to those that are discharged into the condenser. Sensible men will not attempt the first, but if the two methods could be conducted with equal accuracy, they would, apart from the waste of heat attendant on transmission through the cylinder, necessarily give the same result. The saving of heat that is proved by its absence from the condenser, is exhibited in the boiler by its retention.

Now, Mr. Frost is not content with choosing between these two methods, but insists on saving his heat twice; once in the boiler, in the ratio of 49 to 12, and again in the condenser in the far-

different ratio of 14 to 9. This will never do. His conduct is like that of a man, who having been engaged for some time, and much to his satisfaction, in a qualitative and quantitative analysis of a bottle of pleasant liquor, appeals to the fair companion of his life as to the number of glasses on which he has experimented. He is told that the half empty state of the bottle indicates he must have taken six; but being either under the influence of the said pleasant liquor, or else being possessed of a true Hibernian exuberance of ideas, he arrives himself at the sage conclusion that the number must be twelve, for have not six vanished from the bottle? and have not six vanished he knows where?—and that's a dozen any how. Mr. Frost's mind is in the same state of confusion, although with the advantage on his side of having had the tee total element for the subject-matter of his cogitations. He looks at the boiler, and sees that a quantity of caloric has been abstracted—he looks at the condenser and sees that the temperature of its water has increased, and although this is a necessary consequence of the transference of steam, and therefore of heat from one to the other, he insists on measuring it, both before and after it has passed through the cylinder.

It is obvious that the state of the condenser affords the only satisfactory evidence in these comparative experiments. By this test the expenditure of heat is in the ratio of 14 to 9, or the saving is 35 per cent. By the boiler test, the ratio is as 49 to 12, or the saving is 75 per cent. Now the great difference in these results, when there ought not to be any, arises, not only from the difficulty—I may say impossibility—of getting any accurate indications from the boiler, but from the absurd manner in which Mr. Frost has attempted it. He takes the differences of temperature in the condenser very properly for the terms of the ratio in that case; but in respect to the boiler, he takes the two extremes of the pressure of the steam! Even allowing him to substitute pressure for temperature, as a sufficient indication of it, and supposing that he had taken the differences instead of the extremes, he would still have been altogether wrong whilst neglecting to take into account the con-

tinual influx of heat from the furnace. In the second experiment, the difference is positive, instead of being, as in the other case, negative; and thus the transmission of heat being ignored, Mr. Frost would have arrived at an inconveniently triumphant result—namely, that the heating the steam more than supplied all the power required by the engine.

The condenser, we have seen, indicated a saving of heat to the amount of 35 per cent.; and I know no reason why we may not place dependence on this result: still it will be necessary to make some qualifying remarks. No information is afforded as to the construction of the boiler, nor of its evaporating power in relation to the demand for steam. It may have been that it was overtaken in this respect, as boilers too generally are; either from this cause, or from insufficient steam space, or from cramped and narrow steam ways, the steam may have been rendered in more than a usual degree watery, and as heat in this way passes into the condenser in an inefficient form, it would be wasted to a more than ordinary extent. The economizing of heat under such circumstances, if they really occurred, would be no fair criterion of what would take place under better yet common arrangements.

There is another qualifying observation to make. A saving of fuel is not a necessary result of a saving of heat. Caloric is wasted as well as used, and, whilst economizing in one direction, we may be losing in another. The condenser may give evidence of a less consumption of heat, and yet there may be a greater consumption of fuel; for as caloric is always more largely evolved than taken up by the steam, this wasteful surplus may be augmented by the very means employed to convert into work a greater proportion of the quantity absorbed. Whether the separate heating of the steam is, or is not, accompanied with this result, no attempt to ascertain it appears to have been made.

What are we to think of the attestations to these inconclusive experiments?—Do they refer also to the absurd calculation of the value of Mr. Frost's improvement? Surely these gentlemen—among whom is to be seen the Principal of New-York University—did not mean to certify more than the fact of their

• having been witnesses of the experiments; and yet it does not appear that they have protested against the use of their names in a way that would lead to the impression that they guaranteed also the accuracy of the calculated results.

There is no doubt that, with our present arrangements, heat is very much wasted by the watery condition of the steam. The great fault is the small size of the boilers. Some years since I recommended a friend to have a boiler 16 feet long and 3 feet in diameter, for a 5-horse high-pressure engine. Subsequently, in contemplation of a larger engine, a 24-feet boiler, of 3 feet diameter, was also laid down. It was soon perceived that even this larger boiler was not too great for the same engine. When used alternately with the other, it was soon manifest that it was more economical; and its convenience in regard to the varying demand for steam, occasioned by the exceeding irregular work of the engine, was very great. The important advantage of producing little smoke belongs also to large boilers; with proportionate furnaces and judicious stoking, there needs no especial apparatus for effecting this object. It may surprise many to be told, but it is a fact, that no ordinary kitchen fire produces, not merely relatively to the amount of coal consumed, but absolutely so little smoke as a well-ordered and well-managed steam-engine furnace, and that without any smoke-consuming contrivances whatever. But, returning to the subject of dry steam, the French engineers say, that the carrying the flue in its second course round the boiler, somewhat above the water-line, is attended with considerable advantage; but I should fear that it is not quite a safe expedient.

I am, Sir, yours, &c.,
BENJAMIN CHEVERTON.

PAINE'S AMERICAN LIGHT.

SIR:—The very strange statements made in some American letters, which have appeared in a recent Number of your Magazine, on "Paine's Light," "Catalysis of Hydrogen," &c., have induced me to make some experiments, by which it is clear to me that the luminosity of the flame from hydrogen passed

through turpentine (I have found mineral naphtha to answer better) is due to the carbon, derived, no doubt, from the turpentine or naphtha which the gas may absorb in its transmission through the liquid. The presence of carbon in the flame may be easily demonstrated by holding in it a porcelain plate or something of that kind, on which some of the carbon will be deposited.

I think the combination of the liquid and hydrogen is more mechanical than chemical—perhaps analogous to the absorption of moisture by common air. The illuminating power may be almost entirely abstracted by passing the gas through water after having been impregnated with turpentine or naphtha, and completely so, by passing it through oil (I used olive oil). This state of combination may account for the fact that a small proportion of carbon produces a light with hydrogen equal to that produced by a very much larger proportion when *chemically* combined with the hydrogen, as in carburetted hydrogen and light carburetted hydrogen.

So much for the "catalyzed" hydrogen. I have not yet analyzed the rest of the magic.

I advise the American pseudo-philosophers, in attempting to give the *rationale* of phenomena, *new to them*, to give it *rationally*.

I am, Sir, yours, &c.,

JOSEPH W. SWAN.

Newcastle-on-Tyne, Feb. 20, 1851.

IMPROVEMENTS IN SHIPS' MAGAZINES, BY C. W. COPELAND.

THE patentee's improvements in ships' magazines, consists in a new and improved method of constructing the magazines, of ships of war, by which the magazines are rendered perfectly safe from fire, and the ship protected from the danger of explosion during action, or from accidental conflagration. Also in a means of communicating with the magazine, without risk from external fire, even should the ship be on fire.

The magazine should be constructed of sheet metal, and have a lens in the top or sides as usual; it should also be provided with a cock or plug in the bottom, for

the purpose of allowing the escape of water, that may enter in the course of the use of the safety apparatus, which is constructed as follows:—Two tubes are adapted to the magazine, both communicating with the side of the ship, below the water-mark, one near the top, and the other near the bottom. These tubes have each a valve placed in them, near the magazine, which opens and shuts them; so that when the valves are open, the water can enter through the tubes into the magazine. When the apparatus is fixed for use, the valves are kept closed by a spring, which counterbalances the effect of a weight, acting by means of a short lever, which is placed so as to open them, the instant the spring is let go. To the spring is adapted some piece of easily fusible material, gutta serena, for example, and by this piece of fusible substance, is the spring retained in its place. The materials of which this piece is composed, being of such a nature, that the slightest heat will melt it, and cause it to part asunder, especially being aided by the force of the weight, which tends to open the valves, it follows, that long before any fire could reach the magazine, the connecting piece will have given way, and thereby opened the valves, and allowed the water to flow in. It is stated, that the reason for placing one tube at the top of the magazine, and the other at the bottom, is to create a circulation of cold water through the magazine; which circulation, it is also stated, would be produced by the heat acting upon the exterior of the magazine, and causing the water to rise to the top as it is heated, and to flow out through the upper tube, while fresh cold water would enter through the lower tube to supply its place.

The means of affording ingress and egress to the magazine without danger from external fire, at all times, is by two concentric cylinders, the inner of which fits the outer one exactly, and is arranged so as to turn round within the outer one. The outer one fits into a packing ring, let into the top of the magazine, through which the outer cylinder can be moved up and down, with the inner one within it. When it is down the covers of the cylinders, of course, cover over the hole.

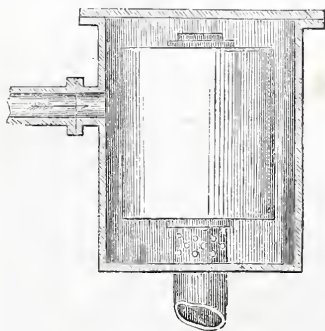
These cylinders have a corresponding portion of their surface cut away, sufficient to allow of a person entering.

When it is desired to send any one into the magazine, the cylinders are drawn up, and the open portions of both surfaces brought together; through the opening thus made, the person enters. The inner cylinder is then turned round, so that both openings are closed, and then they are both let down. When down, the inner one is again turned round, so that the openings correspond, and the person steps out into the magazine. A similar operation is performed for the person's egress. By this means, during the person's entering and leaving the magazine, it is entirely closed to the outside; and powder might even be placed into it, or taken out of it, while the ship was on fire.

The patentee claims —The attaching or adapting a strap or piece of easily fusible matter to the valves of the tubes, as above described, and which strap or piece by the action of heat would be melted, and opening the valves, would thereby allow the water to fill the magazine, and keep up a circulation throughout it, if required; and also the means of affording ingress and egress to the magazine, as above described, at all times, and without any danger from external fire.

DISCHARGE-VALVE FOR WATER IN STEAM PIPES.

The sketch represents Braidwood's apparatus, the valve-case being in vertical section. The case contains a cylindrical



copper float, having a tube passing through its axis, and fitting water-tight over a fixed interior tube, closed at the top. This inner tube forms the discharge-way for the water, and is bored with a series of small holes close to the bottom of the case, through which the tube passes.

When the water flows into the case, as indicated by the arrow, it elevates the float to the position in which it is delineated. The water then flows off through the holes, and the falling of the float brings the outer tube over the holes, and stops the external communication. This plan works under any pressure of steam, as the pressure is the same at top and bottom, or in other words, it is balanced.

Johnstone, Dec., 1850.

As an offset to the many discouraging notices we receive of the appearance of the American portion of the great Exhibition in Hyde Park, we append the following from the London Athenæum.

FOOD.

An American gentleman, walking through the Exhibition, was somewhat cheered when looking round on the empty spaces and half-filled cases devoted to the United States, by the remark of an Englishman, that at any rate America had the advantage in her specimens of corn and maize and salt meat, which might be said to be the raw material of the whole Exhibition. This is a true statement of the fact,—and it indicates the most important relation of America to Europe. The inhabitants of the Old World do not seek the shores of the New to indulge their taste in the fine arts, or provide themselves with luxuries to deck their tables and adorn their palaces. It is the demand for food—lying at the root of all more transcendental tastes—which drives the European to America. How fitly, then, are the United States represented by ploughs, harrows, drills, wagons, sacks of corn, ears of maize, and barrels of salt meat,—by indications of the space and specimens of the fruits which they have to offer to an over-crowded continent! It is one of the drawbacks to the testing here the substances used as food, that the visitor is not allowed to try them by the sense to which they especially appeal. We can therefore report only from sight:—and, so far as that enables us, with regard to the United States' exhibition of these articles, we may say that the samples of wheat, maize, and other grain indicate at once the fertility of the soil and the good management of the farms on which they have been grown.

REVIEWS.

Lieut Maury's investigation of the Winds and Currents of the Sea. Published by authority of the Secretary of the Navy.

We have read the document with much interest, and for the first time are made aware that the results of this indefatigable officer's exertions had already been seen, in the increased safety to navigators in traversing the ocean under the guidance of his charts and directions. The logs of vessels provided with these current charts, show clearly the practical value of his investigations, and the government do well in making public facts of so paramount importance to the increasing commerce of the country.

We never have anticipated much from the scientific investigations or observations of our Naval Officers, as the course of study until lately pursued in the Navy was not of the character to foster deep scientific research, and we have deplored the efforts, which from time to time have been made, to transfer the direction of the Coast Survey to the Navy Department.

The acquirements of the *very* young officers before seeing active service cannot be of a very high order, and during active service there is but little inducement and less opportunity to make up for the early deficiency, consequently none but those of strong scientific tastes are likely to become adepts in scientific investigations, and the consequences are very likely to be, the intrusting delicate operations to officers, who from their position are supposed to be proficient in matters which in truth are either distasteful to them, or whose value they cannot appreciate, and in consequence they are not likely to receive that degree of attention which their importance demands.

We have been led to these remarks by noticing the frequent changes made in the Naval Officers stationed at the National Observatory at Washington.

When we consider the importance of this institution, and the peculiar talents required for an observer, and how rare it is to find those talents combined in the same individual, still less confined to a *class of indivi-*

duals, we cannot but deprecate the miserable economy of a government which, squandering millions upon worthless objects, begrudges the few thousands necessary to place some of its most vital interests in safe keeping. The National Observatory is not a school for young Midshipmen to learn that there are other scientific works than Bowditch's Navigator in print; nor is the marling-spike, as some appear to think, an astronomical instrument.

The present accomplished Superintendent, Lieut. Maury has qualified himself by vast study and labor for the important post he holds. We know of no one in any service better fitted for the duties of his office. But give him a corps of assistants of his own selecting and permanent; and not harass him with the drudgery of school teaching.

The parchments of none of our secretaries can confer either scientific tastes or acquirements. Then why should the duties at our National Observatory be confined to officers of the navy, and subject to constant change.

The pay of assistants would be literally nothing, compared with the advantages likely to result from giving the Superintendent complete and entire control over his assistants, and detaching the institution entirely from under the control of the Secretary of the Navy. We are well aware of the causes which influenced the present state of things there—but they no longer exist. The public are now satisfied of its value—(thanks to Lieut. Maury's perseverance and energy,) and a niggardly economy should no longer be suffered to hamper and clog an institution, in the success of which the whole world have an interest.

We notice in a late number of the London Mechanics' Magazine, a review of Griffith's Treatise on the Theory and Practice of Ship-Building, and we most heartily concur in the opinion therein expressed of the work. We have read the book—thanks to a large type and "lovely margin," and truth compels us to say, that if it had been an English work, making the pretensions it does to being so much in advance of the age, it

would have been utterly impossible for us to have dealt with it so mildly as the editor of the London Mechanics' Magazine has done.

Our countrymen being acknowledged skillful in ship-building, has led to a notice of this work abroad, and if the author had confined his remarks to matters of practical detail, it might have been worth to the purchaser, at least, the value of the paper and printing; but the author, not content with exhibiting what he really knew, must needs exhibit what he was profoundly ignorant of, and in a stilted "high-faluting" style, absolutely nauseating, has rendered his bad taste in literary composition as conspicuous as his ignorance of the sound theoretical principles of his art.

We do beg of our mechanics to recollect, that poverty of language is no bar to the exhibition of truth; whereas poverty of ideas cannot be disguised by a high flourish of words. When one opens a work professing to treat on mechanical subjects, and finds the author aiming at a grand and lofty style of composition, which he fails to reach, contempt for his weakness will be very likely to obscure any admiration we might otherwise have had for his talents.

PATENTS.

List of Patents (with claims annexed), which issued from the United States Patent Office from the 22d day of April, 1851, to the 6th May, 1851, both inclusive.

TO I. I. CADY, of New York, N. Y., for *Improved Compound Metallic Door, for Vaults, Safes, etc.* Patented April 29, 1851.—I claim a door or wall, for a vault or safe, made by securing to each other, at a certain distance apart, two plates of sheet metal provided with a rim or curb, and filling the vacant space between them with unmalieable cast iron, poured in while melted.

TO OLIVER ETNIER, of Shirley Township, Pa., for *Improvement in Winnowing Machines.* Patented April 29, 1851.—I claim placing the screen in an inclined position above the fan, and extending the whole length of the machine, by which the wheat is thoroughly sifted before being acted on by the blast, in combination with the direction of the blast, at right angles to the screen.

TO J. C. SMITH, of Stoughtstown, Pa., for *Improvement in Spring Saddles.* Patented April 29, 1851.—I claim the pommel spring,

in combination with the seat spring, as set forth. I also claim the method of suspending the stirrups, by connecting them with the same springs which support the seat, whereby the elevation and depression of the one is simultaneous with the elevation and depression of the other.

To J. GOSHON, of Shirleysburgh, Pa., and WM. H. TOWERS, of Bucyrus, Ohio, for *Improvement in Apparatus for giving ease to the Arms in Writing*. Patented April 29, 1851.—We claim constructing an arm supporter, or rest, so formed and shaped as to fit the arm below the elbow joint, and serve as an elastic or flexible support or rest, on which the arm of the penman is supported and balanced, and permitted to move or turn with the motion of the arm, with the utmost freedom and ease to the writer, by which all numbness, contraction of the muscles of the fingers, and crampness or stiffness of the arm, is effectually prevented, and the arm rendered free in its movement, and under the complete control of the writer.

To IRA H. SMITH, of Wolcott, Conn., for *Improvement in Machinery for making Matches*. Patented April 29, 1851.—I claim, first, the mode of feeding in the plates of wood, by means of the feeding apron with its cleats, spring, pulley, and rollers. Second, the mode of separating and dipping the splints, by means of the grooved cylinder, cutter, endless bands, and revolving wheels.

To II. G. BABCOCK, of New London, Conn., for *Improved Horseshoeing Machine*. Patented April 29, 1851.—I claim, in combination with a rotating travelling draw-roller, adjustable pattern, and clamping tool for forming the shoe, the gauge plate for holding up the roller, so as to allow it to return over the shoe thus formed and smooth down the feathered edges raised by the chamfering tool.

To L. W. BOYNTON, of South Coventry, Conn., for *Improvement in Bats for Felting*. Patented April 29, 1851.—I claim preparing the web for felt fabrics, by the introduction of layers of flock between or upon the layers of wool, without passing the flock through the carding machine, but by preparing it in a separate machine, and introducing it immediately from that machine on to the web of wool, while it is passing from the carding machine. And I also claim the combination of the endless apron, which feeds the flock to the cylindrical brushes, with the series of cylindrical brushes by which the flock is taken up from the inner extremity of the endless apron, and, passing through the series, is prepared and sent down through the spout or conductor, and deposited on the web of wool, as before described, when the same is constructed and combined.

To L. L. GILLALAND, of Dayton, Ohio, for *Improvements in Split Machine*. Patented April 29, 1851.—I claim a cutter wheel, constructed substantially as herein set forth, to split, point, and gauge the size of match splints, in combination with the method of preventing the splitting knives from cutting

across the grain of the wood, by supporting the block upon a stock, which is constructed to turn, as herein set forth, to present the grain of the wood, where the splitting knife is acting in line with the plane in which the knives revolve.

To WM. MT. STORM, of New-York, N. Y., for *Flexible Hose or Float, for supporting Vessels*. Patented April 29, 1851.—I claim, first, a plan of supporting a vessel, in whole or part, upon or by means of a flexible, movable, endless hose or air-float, or on an endless movable chain of flexible, buoyant compartments. Second, I claim making my flexible hose air-float, or its equivalent, collapsible, for the purposes set forth. Not limiting myself, in or by these claims, to any particular forms or arrangement of the buoys or floats, &c., so long as the peculiar textures of my invention, as described and claimed, are substantially fulfilled.

To LINUS HALE, Jr. of Newport, N. Y., for *Improved Lock and Key*. Patented May 6, 1851.—I claim, first, the self-detaching and attaching key, for the purpose and object described. Secondly, in combination with said key, I claim a powder proof key-hole, consisting of two or more parts, so constructed that the outer part is turned by the key, while, at the same time, the inner parts, with the pod or pods of the key inclosed, are disconnected and moved entirely away from the outer, the same movement causing solid metal to occupy the space left, and thus to effectually bar an entrance of any kind to the lock, when its parts are in a position possible to be unlocked.

To THOMAS VANDERSLICE, of Valley Forge, Pa., for *Improvement in Meat-Cutting Machines*. Patented May 6, 1851.—I claim the herein described mode of adjusting the cutters by means of the adjusting plates.

To CHARLES BURT, of Belfast, Me., for *Exploding Harpoon*.—Patented May 4, 1851.—I claim, first, the interior of the harpoon made as a pistol barrel, with percussion lock protected from water or outward accident, and the trigger of which can be actuated by means of a pull on the line, and the resistance of the flesh. Second, I claim the making the point of the harpoon the projectile which is shot into the whale, in the manner and for the purpose described. Third, I claim the arrangement of the trigger in the shank under the barb in the mode prescribed, preventing the explosion of the charge until the line is drawn by the whale or the harpoon.

To JOHN R. ST. JOHN, of New-York, N. Y., [assignor to JAS. RENWICK, Geo. F. BARNARD, and Edward B. St. John.] for *Improvement in Hand Logs*. Patented May 6, 1851.—I claim, first, the arrangement of the log-glass, lever, pinion, and wheel, whereby the motion to the clockwork by the reel is communicated to the index during a definite period of time, determined by turning the log-glass on or off the lever, the parts being so proportioned, and the dial so divided, that the index, moving while the sand is running

in the log glass, shows the rate of speed at which the vessel is moving per hour of time, during fourteen seconds, or any other known space of time; the parts being arranged and operating substantially as described or in a manner equivalent, to produce the same results by like means. Second, the application of a parachute to the purpose of a "log ship," and the combination therewith of the cylindrical wedge or its equivalent, to enter between the tubes to keep the "log ship" spread, when in the water, and disengaged when hauled on to "fetch home," so that the log ship closes and turns end for end with the water, and is easily hauled on board, said log ship being used with the reel and registering parts herein described and shown, or with any other means of supplying and determining the amount of line run out during a known period of time.

TO NELSON GOODYEAR, of N. Y., for *Improvement in the Manufacture of India-Rubber*. Patented May 6, 1851.—I claim the combining the India-rubber and sulphur, either with or without shellac, for making a hard and inflexible substance hitherto unknown. And I also claim the combining of India-rubber, sulphur, and magnesia, or lime, or a carbonate, or a sulphate of magnesia, or of lime, either with or without shellac, for making a hard and inflexible substance hitherto unknown.

TO JAMES R. KAIN and SPENCER LEWIS, of Tiffin, Ohio, for *Improvement in Bedstead Fastenings*. Patented May 6, 1851.—We claim providing the upper section or part of the cylindrical box, with a triangular and two parallel wedge-shaped wings, made sharp and projecting from its periphery, in such a manner that the triangular projection shall open a groove or way in the post, which shall be closed by the entrance of the parallel wedge-shaped wings, which follow as the section is driven into the post, and thus crowd the wood in front of the shoulder of the triangular projection, and form a complete lock thereto. We also claim dividing the cylindrical box longitudinally into two equal parts or sections, the line of division inclining upward at an angle of about 10 degrees from a horizontal plane, by which the edges of the upper section are made to serve the purpose of wedges for forcing the teeth of the lower section into the post and holding it securely.

TO JAMES A. CUTTING, of Philadelphia, Pa., for *Improved Spark Arrester*. Patented May 6, 1851.—I claim, first, the air flues in the lower part of the diaphragm constructed in the manner described. Second, I claim the pipes or conductors in combination with the air chambers [two] arranged substantially as described. Third, I claim the combination and arrangement of the air flues with the air chamber, reverberating cone, inclined and curved flues, for the purpose described.

TO NELSON NEWMAN, of Cincinnati, O., for *Improvement in Pumps*. Patented May 6, 1851.—I claim the combination and arrangement of the valve chest, water passage, pump

cylinder, and air vessel, as herein described, so that the whole can be cast in a single piece, and the valves and suction pipe supported and secured in place by another piece also cast in the form herein described, whereby the cost of making the pump, and its liability to get out of order, are both lessened without impairing its efficiency or rendering it more difficult to repair.

TO RICHARD E. SCHROEDER, of Rochester, N. Y., for *Improvement in Lime Kilns*. Patented May 6, 1851.—I claim the flues encircling the cupola and provided with apertures or flues [five] for admitting the heat and flame to the action upon the limestone from various points, substantially as described, in combination with the air chamber encircling the cupola. And I claim, also, the aperture and passage therefrom, for saving the heat arising from the manufactured lime while being removed, all operating conjointly.

TO JOHN GORRIE, of New Orleans, La., for *Improved Process for the Artificial Production of Ice*. Antedated August 22, 1850. Patented May 6, 1851.—I wish it to be understood that I do not claim as my invention any of the several parts of the apparatus in themselves, but I claim, first, the employment of a liquid uncongealable at the low temperature at which it is required to keep the engine, to receive the heat of the water to be congealed, and give it out to the expanding air. Second, I claim the employment of an engine for the purpose of rendering the expansion of the condensed air gradual, in order to obtain its full refrigeratory effects, and at the same time render available the mechanical force with which it tends to dilate, to aid in working the condensing pump, irrespective of the manner in which the several parts are made, arranged, and operated. Third, I claim supplying the water gradually and slowly to the freezing vessels, and congealing it by abstracting the heat from its under surface, substantially as set forth. And lastly, I claim the process of cooling or freezing liquids by compressing air into a reservoir, abstracting the heat evolved in the compression, by means of a jet of water; allowing the compressed air to expand in an engine surrounded by a cistern of an unfreezable liquid, which is continually injected into the engine and returned to the cistern, and which serves as a medium to absorb the heat from the liquid to be cooled or frozen, and give it out to the expanding air.

TO FLORENTIN JOSEPH DE CAVAILLON, of Paris, France, for *Improvement in Purifying Illuminating Gas*. Patented May 6, 1851.—I claim the purifying powder for illuminating gas, said powder consisting of sulphate of lime, either natural or artificial, in connection with some inert substance or substances, partly inert and partly rendered purifiers, when compounded in the proportions substantially as described.

TO THOMAS J. SLOAN, of New-York, N. Y., for *Machine for assorting Screw Blanks, etc.* Patented May 6, 1851.—I claim the combination of the series of shifting ways, with the

main or stationary ways, in the manner substantially as specified. And I also claim the detector, in combination with the stationary and shifting ways, for the purpose specified.

Re-Issues.

To FRANK CHENEY, of Manchester, Conn., for *Improvement in Machinery for Doubling, Twisting, and Reeling Thread*. Originally patented Oct. 9, 1847. Re-issued April 29th, 1851.—I claim the described combination of doubling, twisting, and reeling mechanism, or elements, constructed, applied, and operating together, whereby I am able to double, twist, and reel each thread by the same machine.

To J. BURROWS HYDE, of New York, N. Y., (assignor to Thos. J. Croggon, administrator of T. R. Williams, deceased,) for *Improvement in Machinery for Hardening Bats in Felting, &c.* Patented Dec. 14, 1840. Re-issued May, 1851.—What is claimed as the invention of the said Thomas Robinson Williams, is the method of forming the bat by the combined use of two endless aprons which receive the sliver from the doffer, or a carding engine, or otherwise, between them, and form the bat on one of the belts, whilst the other acts as a support.

To J. BURROWS HYDE, of New York, N. Y., [assignee of Thos. Croggon, administrator of T. R. Williams, deceased,] for *Improvement in Machinery for forming Bats for Felting, &c.* Patented Dec. 14, 1840. Re-issued May 6, 1851. What is claimed as the invention of the said Thomas Robinson Williams, is, first, the method of hardening the bat, by passing the same between two series or tiers of rollers, covered with cloth, or otherwise, and arranged over each other, the one series being provided with a reciprocating, endwise motion, for the purpose of felting the bat; and the other series with a progressive rotary motion, for the purpose of feeding the bat through, with or without the use of a trough, containing hot water and soap-suds or other matter.

Designs.

To THOMAS BALL, of Boston, Mass., for *Design for Bust of Jenny Lind*. Dated April 29, 1851.

List of English Patents issued from March 31, 1851, to April 24, 1851.

John Gwynne, of Landsdowne Lodge, Notting-hill, Middlesex, merchant, for improvements in machinery for pumping, forcing, and exhausting of steam, fluids, and gases, and in the adaptation thereof to producing motion to the saturation, separation, and decomposition of substances. (Being a communication.) March 31; six months.

John Peter Booth, of Cork, Ireland, leather purifier, for an improved manufacture of fabric applicable to the construction of muffs, coats, tippets, and other like articles, and also to the ornamenting of articles of dress and furniture, and other similar uses. March 31; six months.

Louis Brunier, of Paris, civil engineer, for improvements in obtaining power by the use of steam or compressed air. March 31; six months.

Joseph Richardson, of Halifax, York, dyer, for improvements in dyeing and cleansing piece goods. March 31; six months.

Auguste Motte, of Southwark, Surrey, manufacturer, for certain improvements in portmanteaus. April 2; six months.

Thomas Hucksvalle, of Choice Hill, Oxford, for improvements in treating mangle-wurzel, and in making drinks and other preparations therefrom. April 2; six months.

Richard Archibald Brooman, of the firm of Messrs. J. C. Robertson and Co., of Fleet-street, London, patent agents, for improvements in machinery for the manufacture of rope and cordage. (Being a communication.) April 2; six months.

William Barker, of Hulme, near Manchester, millwright, for improvements in machinery for chipping, rasping, and shaving dyewood, and other materials, and in apparatus connected therewith. April 7; six months.

Christopher Cross, of Farnworth, near Bolton, Lancaster, cotton spinner and manufacturer, for certain improvements in the manufacture of textile fabrics, and in the manufacture of wearing-apparel from textile materials. April 8; six months.

John George Appold, of Finsbury-square, gentleman, for improvements in machinery for regulating and ascertaining the labor performed by manual or other power. April 9; six months.

Charles McDowall, of Hide-street, Bloomsbury, Middlesex, watchmaker, for certain improvements in the construction of time-keepers. April 10; six months.

Henry John Betjemann, of Upper Ashby-street, Northampton-square, Middlesex, for improvements in connecting parts of bedsteads and other frames, and in machinery employed therein. April 15; six months.

Frederick William East, of the firm of Thomas East and Son, Bernondsey, leather-dressers, for improvements in dressing, embossing, and ornamenting leather. April 15; six months.

Benson Stones, of Warwick-street, Golden-square, Middlesex, for improvements in the use and treatment of peat and its products, and other carbonaceous matters; and also for apparatus applicable to such and other chemical purposes. April 15; six months.

Herman Schroder, of Bristol, gentleman, for improvements in manufacturing and refining sugar. April 15; 6 months.

Antoine Victor Contant, of Paris, France, iron-master, for an improved mode of partially hardening iron for various purposes. April 15; six months.

Thomas Greaves Barlow, of Bucklersbury, London, civil and consulting gas engineer, and Samuel Gore, of Park-road, Old Kent-road, engineer, for improvements in the treatment of certain substances used in the production of gas for giving light and heat, and of some of the products of the said substances, as also in the apparatus employed in the manufacture of such gas, and in discharging and giving motion to gas. April 15; six months.

Charles Hardy, of Low Moor, York, engineer, for certain improvements in the manufacture of scythes. April 15; six months.

Robert Newell, of New-York, in the United States of America, lock manufacturer, and a citizen of the said States, for certain new and useful improvements in the construction of locks. April 15; six months.

Frederick Puckridge, of Kingsland-place, Middlesex, merchant, for improvements in the preparation or manufacture of materials of fabrics suitable for ornamenting furniture and other articles. April 17; six months.

Thomas Keely, of Nottingham, manufacturer, and William Wilkinson, of the same place, frame-wrok knitter, for improvements in machinery for manufacturing textile and woven fabrics, and other articles composed of fibrous or filamentous materials; also for improvements in the said fabrics and articles. April 17; six months.

William Andrews, of George-street, Westminster,

mechanic, for certain improvements in steam-engines, and in boilers, in pumps, in safety valves, and in wheels and axles. April 24; six months.

William Smith, of Snow-hill, London, gas-meter maker, and Thomas Phillips, of Brighton, gas fitter, for certain improvements in apparatus for heating, ventilating, and cooking by gas. April 24; six months.

Robert Hawkins Nicholls, of Pimlico, Middlesex, gentleman, for improvements in machinery for giving motion to agricultural and other machinery. April 24; six months.

Joseph Clinton Robertson, of the firm of J. C. Robertson and Co., of 166, Fleet-street, London, patent agents, for improvements in musical instruments. (Being a communication.) April 24; six months.

CORRESPONDENCE

To the Editor of Appleton's Magazine.

Sir, when the advocates of any system cannot agree among themselves, I think we are justified in doubting the theory altogether; but if that which is advocated by some of its advocates be absolutely absurd, and yet further, if arguments can be adduced which appear to render the theory impossible, surely unbelief becomes a positive duty.

Now to apply these remarks to the pendulum experiment, one man in England, says, it would require 24 hours to complete a revolution which is confirmed by an experimenter in New-Jersey, while the savans of Boston have asserted it to take 35½ hours, and those at Washington, 48 hours. Such incongruity does not bear the stamp of truth. It has been affirmed by many, that it would make a complete revolution at the poles in 24 hours, but that the time necessary for a revolution would be longer and longer as you approach the equator, where there would be no revolution. If it really does take longer and longer as you approach the equator, it is obvious that the reason it does not revolve there, is because this longer and longer time becomes, as you approach that line, so long that it takes to all eternity to finish it: if this is not absurd I can form no conception of the ridiculous. As to the argument to prove that the pendulum experiment cannot be a visible proof of the revolution of the earth, (as I wrote you a month since,) I cannot see it in any other light than there represented, although I have carefully read all I have seen on the subject.

Yours respectfully,
C. DOWDEN.

To "A. S. Du. P.," *Wilmington*.—Our thanks for the article on "Turbines." It will be inserted in our next.

A correspondent's notice in reference to Architectural matters, is favorably received. Our own tastes would certainly lead us to devote a large space to this branch of art; but as we have regarded it and studied it *as an art*, and not as a trade, our remarks would be distasteful to the majority of its practitioners, with-out, we fear, being of much service to them.

From our London Correspondent.

LONDON, MAY 30th, 1851.

"DEAR SIR:—I have been in the Great Exhibition day by day since its opening, actively engaged in examining the machinery exhibited there, and find my previous statements as to the progress made in England in the cotton manufacture, fully confirmed. In my last letter, I mentioned to you that the plan used

in England for dressing warps was quite different from the one in general use in America. I now send you an engraving of the dresser exhibited at this Exposition; and a circular, containing the *points* of the looms exhibited by the same parties, and which are considered by mechanics as being the best now in use here. A loom made under these patents is now in the possession of the Essex Company, at Lawrence, having been sent out by me two months since, and I am obliged to refer you to them for information as to its exact construction. There are two of them running at the "Crystal Palace," on a very unsteady floor, at 240 picks per minute. These are tended by a boy of 18; and he could tend *three* easily, and I think *four*, at the same speed.

The display of machinery is very wonderful, comprising two large sets of cotton machinery from Hibbert & Platt, and Parr, Curtis, and Madely. Two sets of flax machinery from Higgins & Sons, of Manchester, and Dawson & Sons, of Leeds; one set of tow machinery, also from Lawson's; a set of silk machinery from Derby; one of worsted machinery, from R. Berry, of Bradford; a wool-combing machine, from George Donisthorpe, of Leeds; built by Taylor & Wordsworth, of the same place. An improved "McCulley" throstle, with the live spindle, from Sharp Brothers, of Manchester, and several magnificent lathes, &c., from the same firm. A complete set of lathes, planers, shaping, slotting, and drilling machines, from Whitworth, of Manchester, by all odds, the most perfect thing of its kind ever exhibited, and which will add new celebrity even to Mr. Whitworth's well known name. You may see grouped around it, daily, the most eminent engineers in the world, admiring the exquisite workmanship, and admirable proportions of the whole contribution. Then we have several very perfect lace machines, from Messrs. Sewall, of Carrington, and R. Birkin, and Ball, Dunncliffe, & Co., of Nottingham. A mathematical power-loom for sail-cloth, from C. E. & C. Parker, of Dundee. A rope-making machine, from I. Crawhall, of Newcastle-upon-Tyne. A very beautiful double-action Jacquard loom, invented by a poor mechanic of London, by name A. Barlow, working alternately to the right and left, and raising the warp from cards Nos. 2, 4, 6, 8, &c., while Nos. 1, 3, 5, 7, &c., are changing, and *vice versa*, saving much time, and weaving damasks by power at about 120 picks per minute—about as fast as we run a common cotton loom in New England. Then comes a loom from T. S. Reed, of Derby, for making fringes and like fabrics without the use of shuttles, one of the most ingenious machines in the exhibition, and of which I will endeavor to procure a sketch before my next. We also find a very ingenious machine for forging spindles, being a series of plungers of different lengths of stroke, driven by wipers, from a horizontal shaft above, and raised by springs as the wiper leaves them; it is fast coming into general use here. Mr. Nasmyth, of Manchester, sends one of his renowned steam-hammers; and Messrs. Fairbairn & Sons send cranes, riveting machines, &c. This list comprises the best articles in Class 6, which you will find in the catalogue under its appropriate head, and which is the only one to which I have devoted my time, as yet. I will send you, in another letter, the list of the best things in Class 5. The foreign machinery in Class 6, which will be likely to rank very high in the reports of the Jurors, will be, probably, from America—Woodbury's planing machine, Dick's anti-friction presses, and Eastman's stone-dressing machine; from Prussia, Ulhorn's coining press; from Belgium, a roving-frame from the Phoenix Company; from France, a set of wool cards and jack, from Sedan, and a paper-making machine, from Varrall, Middleton & Elwell, of Paris; from Denmark, a type-setting and composing machine. America might have done much better than she has, had she understood the importance of this show. Great attention is paid by mechanics to a set of genuine American machines for working wood, exhibited by their importer and patentee in

* Too large for insertion in this number.

England, Mr. W. H. Furness, of Liverpool. They comprise a planing machine, from Daniels, of Worcester, Mass., and mortising and tenoning machines, from Fay, of Berlin, Connecticut. The black walnut and bird's-eye maple, of which they are made, stamp their American origin on them in unmistakable characters, and had they been an American contribution from the inventors, they would have stood a good chance for the first-class medal.

So with other things. An American fire-engine would have taken the prize which Canada is likely to bear away; and in printing-presses, or gun-stock lathes, we should have been above competition.

However, we have one thing here which has delighted some of the first mechanics in England. I mean a bank-lock, from Day & Newell Messrs, Babbage, Remie, and Willis, pronounce it the most perfect thing of its kind they have ever seen, and a thorough master-piece. Edward Riddle, Esq., the American Commissioner, is working well for his country, and deserves the highest praise for his efforts."

"T. E." Without being able to cite the authority, our impression is: that so long as the article is manufactured abroad and used in a foreign vessel, neither the maker nor user is amenable to our patent laws.

"Professor A."—Baltimore—With a modesty peculiarly his own, supposes his contribution to be by no means a novelty. So far from it, we have not met the first person, who was not equally ignorant with ourselves of the matter to which he refers as well known. In the words of another *Professor*—"I thank you, kind sir; I owe you one."

"C. D.," Newark, New Jersey.—His communication in reference to the fire annihilator is received, but too late for this number; we never have thought enough of this matter, to justify an opinion of its merits. We will confess to a prejudice in favor of water for this purpose, both on account of its applicability, its pretty uniform diffusion, and consequent accessibility, and its entire effectiveness when properly applied—to say nothing of its manifest economy.

"S. W.'s" communication in answer to the article on the "Strength of Girders" in the June number of the Magazine is received, but too late for insertion in the present number.

We learn from the English papers that it is contemplated to confer the dignity of *Knighthood* upon the landscape gardener, Paxton, as an evidence of their appreciation of the transcendental genius which designed the Crystal Palace, &c.

This is all very well. They who confer the honor are the best judges of the qualifications becoming it. But what shall we do with Bogardus, of Centre-street, city of New-York? for it is indisputable that to him belongs the merit of all the *invention* displayed in the construction of the Palace.

The English have long built wrought-iron houses, but in 1836, when Bogardus was in England endeavor-

ing to carry out his project of cast-iron structures, he could meet with no encouragement whatever; returned to this country, and put up the first cast-iron building of any magnitude ever erected.

With the exception of the dimensions of the Palace, there is no one feature in it which has not been used in this country for years. Any incredulity on this head will be dissipated by a visit to the iron building corner of Duane and Centre streets.

We allude to these facts for the edification of travellers about to visit London, that they may be saved the mortification of the traveller mentioned in the Spectator, who brought home a wheelbarrow as a very useful machine encountered in his travels.

Battery Enlargement.—In the Tribune of the 17th, we see mention of a special meeting of the Chamber of Commerce held to consider this subject. Lieut. Woodhull was introduced, and, as we understand, also Major Delafield, of the Engineers. The former was opposed to the project, on the ground "that the current of a stream must work out for itself a channel representing in its base the arc of a circle; and that if the Battery were enlarged, and perfected by a sea-wall, the current would gradually withdraw from it, forming a bank, and leaving the water shallower at its base." These views were confirmed by Major Delafield. Now, we do not hesitate to say, that it is entirely beyond the skill of any man to predict what would be the precise effect of the proposed enlargement at the Battery.

The regimen of rivers is acknowledged by engineers to be one of the stumbling-blocks in physics. A few laws are sufficiently well understood—a multitude of facts have been collected—but neither the laws nor the facts admit of general application.

That the building of piers and wharves has a tendency to shallow the water near them, there can be little doubt; but that the building of a continuous wall outside of these wharves would have the same effect, may be questioned.

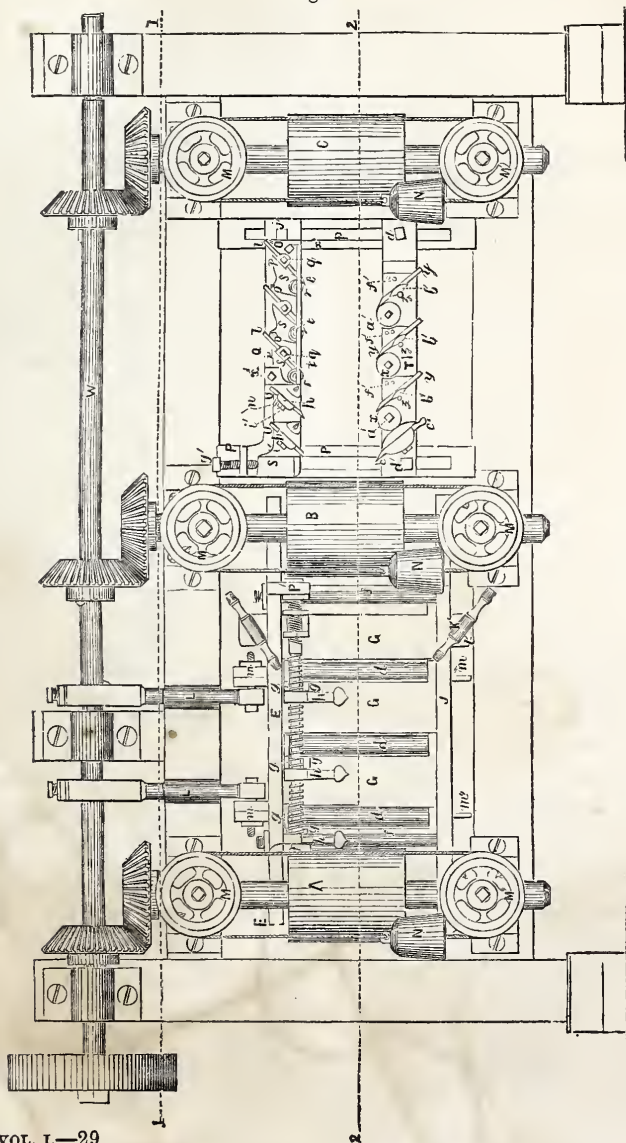
In the mean time we trust our Common Council will not pause in the good work of beautifying and embellishing our dirty city, for fear of filling up the harbor, and in the words of the sapient Chamber of Commerce, "leaving our commerce a prey to rival cities."

Next to the East River Park, there is no embellishment merely, of which the city is susceptible, more to be desired than this extension of the Battery; and our word for it, there is none more harmless.

The Sewing Machine mentioned in the last number of the Magazine, as Wilson's and Watson's, is in fact wholly Wilson's, and is the machine patented by him for sewing heavy articles, as leather. We learn that Watson's connection with it terminated before the patent was obtained.

BARLOWE'S WOOD-PLANING MACHINE.

Fig. 1.



BARLOWE'S WOOD-PLANING MACHINE.

From the Specification of the Inventor, Nelson Barlowe, of St. Louis.

Fig. 1, an elevation of the side of the machine.

Fig. 2, a section and top view, in the line of 1 1, figure 1.

Fig. 3, a section in the line 2 2, of figure 1, as seen from above.

Fig. 4, an enlarged perspective view of the tonguing apparatus, detached from the machine.

Fig. 5, a view of the under side of the said tonguing apparatus.

Fig. 6, a representation of a modified manner of constructing and arranging the tonguing cutters; and

Fig. 7, an elevation of a portion of the rear side of the machine.

Similar letters refer to corresponding parts in all the figures.

The frame work for supporting the operating part of my improved planing tonguing, and grooving machine, may be constructed in any well-known or usual manner.

A A', B B', and C C' are the feeding rollers, for conducting planks or boards into the machine, and retaining them whilst they are being operated upon. The arbors of the rollers A', B', C', revolve in permanent boxes, made fast to the framework of the machine.

The arbors of the rollers A' B' pass through holes near the ends of the plate D, which is located a short distance above the upper ends of the said rollers, and through holes near the ends of the plate I, corresponding in shape with the plate D and placed a short distance below the lower ends of the said rollers. The said plates D and I are united to each other by the bolt rods e e, and form a frame for the reception of the plane stocks H H, which are placed between them, and arranged as shown in figures 2, 3, and 7, and hereinafter set forth.

Lugs t t project from the front corner of the plane stocks, the form of the outer surface of which are segments of circles. These lugs fit accurately into concavities formed in the inner edges of the plates D I, and are secured in their positions by the screws r' r' passing through the side lugs into female screws, formed in the edges of the said plates D I. The mouths of the openings in the lugs t' t, for the reception of the heads of the

screws r r, are reamed out into the form of segments of spheres, to suit a corresponding shape of the heads of the said screws, for the purpose of allowing the said lugs t' t to turn in their beds, as may be found necessary for the proper adjustment of the plane stocks.

The planing knives a a may be secured either to the inner or the outer surface of the plane stocks in any usual or proper manner, but in such positions that their cutting edges will be at the centre of vibration of the plane stocks on their bearings, so that the plane stocks can be vibrated without varying the distance of the edges of the knives from the plank. The after angle of each plane stock (H) forms the mouth-piece of the planing knife that follows it; and the thickness of the shaving to be cut by each knife is therefore regulated by the position of the after angle of the plane stock that immediately precedes it. The planing knives in the series of the stocks H H are intended to have a definite cut upon a plank, to merely remove enough to give it a smooth surface, they are therefore adjusted in the following manner: A regulating screw o' passes transversely across the rear sides of the plane stocks, (H H,) and is supported in lugs a'' a'', descending from the upper plate D; pairs of lugs g'' g'', project from the backs of the plane stocks, above and below the screw o'; nuts a'' a'' are placed on the screw o', on each side of the said pairs of lugs g'' g'', which nuts, by their action on the said lugs, will, when the said screw o' is turned, move the after portions of the plane stocks out or in, and thus cause the planing knives to remove a thick or thin shaving. It will consequently be perceived that when the planing knives are arranged to cut a thick shaving, they will stand at a more obtuse angle to the surface of the plank than when they are arranged to cut a thin shaving. The arbors of the rollers A' B' C' have level pinions on their upper ends, which work into pinions on the driving shaft w.

The plane stocks G G, which are secured in the frame, composed of the plates E J and the rods f f, are arranged in such a manner that they will so adjust themselves as to cause their knives to reduce

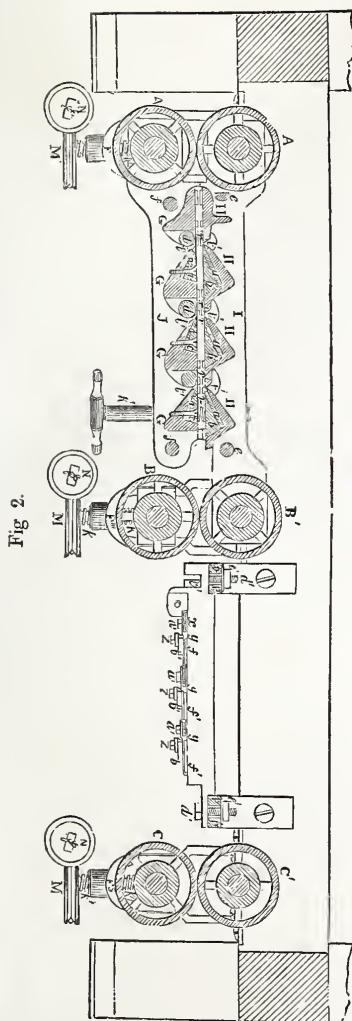


Fig. 2.

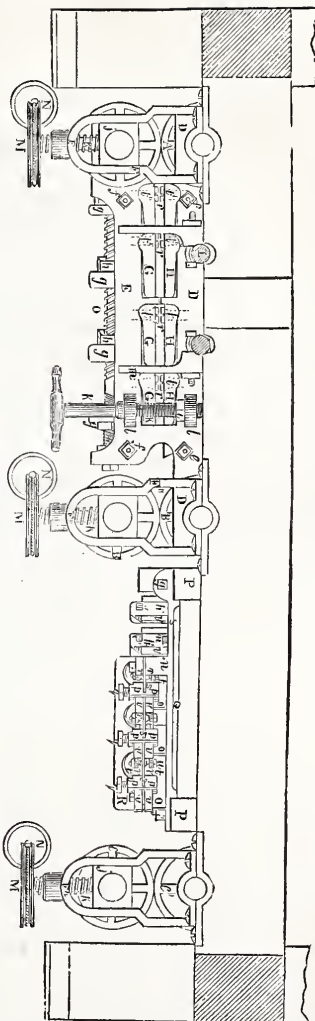


Fig. 3.

the planks that pass through the machine all to a uniform thickness.

The plates E, J, are placed opposite the aforesaid plates D, I, and are embraced between the arms *m, m*, projecting from the plate D; and the arms *m', m'* projecting from the plate I.

At the forward ends of the plates E, J, are holes that receive the arbor of the roller A, and the rear ends of the said plates are connected to the plates D, I, by

means of the set screws *κ κ'*; the former of which passes through the lugs *l, l*, rising from the top plates D, E, and the latter passes through the lugs *l', l'*, descending from the bottom plates I, J.—The set screws *κ, κ'* form fulcrums for the frame E, J, *f, f*, to vibrate upon, in consequence of the play of the said screws in the enlarged holes in the legs *l, l'*, that project from the plates E, J, and they also serve to regulate the distance of the rear end

of the same, from the plane stock frame D, I, e, e, and thus to govern the thickness that the planks operated upon are to be reduced to.

The journals of the arbors of the rollers A, B, C, work in movable boxes *j, j, j*, located respectively in the pairs of supporters F, F', F'', F''', F⁴, F⁵; which boxes are pressed inwards by means of the several pairs of screws *k, k'*, which pass through openings in the outer extremities of the said box supporters, and have pulleys M, M', upon their outer ends, that are respectively connected to each other, by means of bands that support the several weights N, N, N; which weights and bands preserve the arbors of the rollers in vertical positions, and press the rollers uniformly against the planks during their passage through the machine; and the roller A, regulates the position of the plane stock frame E, J, so that the knives in the plane stocks G, G', will cut the requisite thickness of shaving, to bring the planks operated upon all to the required thickness. The threads of the screws *k, k'*, pass around them at an angle of about thirty degrees, to the axes of the same, which inclination of the screw-threads will allow the screws to be turned by pressure against their extremities, and thereby give them an elastic pressure upon the boxes that the arbors of the feeding and retaining rollers work in, which will enable them to give back, whenever it may be necessary to prevent breakage, and also to receive planks of different thicknesses.

The plane stocks G G are secured to the plates E J, by means of the lugs *l' l'* and screws *r r*, in the same manner that the plane stocks H H are secured to the plates D I, as before described, and the knives *a a* may be secured to the said plane stocks in any well known or proper manner, but in such positions that the cutting edges of the knives will be at the centre of the vibratory motion of the said plane stocks.

Lugs (Fig. 3) project from the rear sides of the extremities of the plane stocks G G, which receive the journals of the rollers *d d*, each of which rollers is located a short distance in front of the cutting edge of the knife, in the stock next in succession, and forms the front side of the mouth of the same, for the discharge of its shavings.

The rollers, *d, d*, have to be pressed

back, before the planing knives, immediately in their rear, can operate upon a plank; the plane-stocks, G, G, are made self-adjusting in their positions, so as to adapt the cut of their knives to the varying thicknesses of planks to be operated upon, in the following manner, viz.: A screw, o, whose thread is at an angle of about thirty degrees with its axis, passes transversely across the front of the said plane stocks, (G, G,) and is suspended in the lugs, *p', p'*, descending from the plate, E, pairs of lugs, *g, g*, project from each of the said plane stocks, (G, G,) passing above and below the said screw, o: weighted levers, *h, h*, having female screw openings in their inner ends, are placed upon the screw, o, in such positions as to bar against the lugs, *g, g*, and by the weights at their outer extremities, force the faces of the series of plane stocks, G, G, all into a line with each other, when they are in repose; as shown in figs. 2 and 3.

When a plank or board enters the machine, between the rollers, A, A', it presses against the foremost roller, *d*, and pushes it back, against the elastic pressure of its weighted lever, *h*, to allow the foremost planing-knife to take hold of its definite and distinct portion of the wood to be removed; and so on through the whole series of planing knives.

A greater amount of play is allowed to the foremost roller, *d*, than to those that follow after it, for the purpose of allowing the foremost planing-knife to remove a shaving of sufficient thickness to pass under and take off all the gritty matter that may be upon the plank.

The extent of vibratory movement that can be imparted to the plane stocks, G, G, is regulated by the depth of the recesses in the plates, E, J, that receive the ends of the said plane stocks, shown in Fig. 2. The free action of the plates, E, J, upon the fulcrums of their rear-ends, combined with the elastic pressure exerted upon their forward ends, by the foremost pair of screws, *k, k'*; and their actuating weight, N, serves to distribute the amount to be removed from this side of the plank equally amongst all the knives in the plane-stocks, G, G, save the foremost knife, as above referred to.

On the opposite side of the plank, the fixed cutters in the stocks, H, H, will, at the same time that the knives in the stocks, G, G, are operating, remove just

FIG. 4.

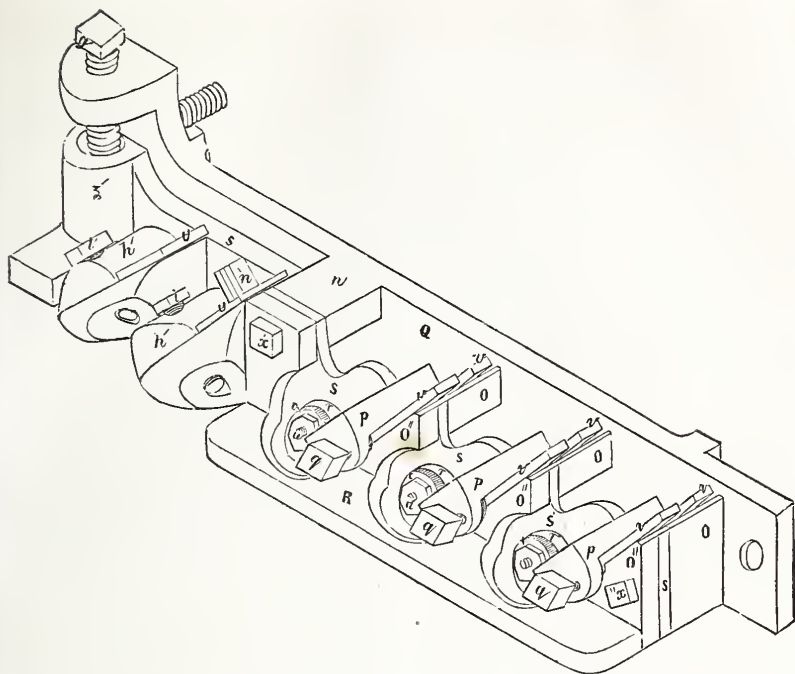
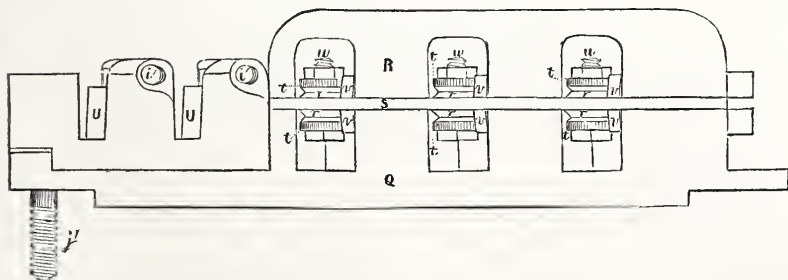


FIG. 5.



enough from the plank to produce a perfectly smooth surface.

By unscrewing the set screws, κ, κ' , the rear-end of the plane-stock frame, E, J , can be swung outwards, upon the arbor of the roller, A , so as to give free access to the inner sides of the plane stocks in both frames. Before adjusting the series of planing-knives, a, a , to their proper positions in the plane-stocks, the inner surface of the said stocks should all be brought into a line with each other, in their respective frames, and then the

knives are brought into their proper positions, by arranging their cutting edges on the same line with the faces of said plane stocks: the rear-edges of the stocks, H, H , are then thrown back a sufficient distance to regulate the cut of their knives, and secured by means of their set-screw, o' , as before described: and the amount of cut of the knives in the stocks, G, G , will be self-regulated by means of the rollers, d, d , acted upon in the manner above set forth.

L, L , are pitmen descending from the

cams on the driving shaft *w*, to the united plane stock frames, and which are jointed to the plate *D*, forming the top of one of the said frames. It will, therefore, be perceived that when motion is imparted to the said driving shaft, a reciprocating motion will be imparted to the said plane stock frames, which will cause the planing knives to have a drawing cut across the fibre of the wood, and thereby enable them to do smoother work, and with less power than can be accomplished with stationary cutters which act by dead resistance.

Instead of connecting the two plane stock frames with each other, in the manner before described, an independent reciprocating movement may be imparted to each frame, which movements of the respective frames may alternate with each other. Or, in place of one of the said plane stock frames, a bed plate, or rollers, may be employed.

After planing a plank, during its passage between the two pairs of rollers *A*, *A'*, and *B*, *B'*, as above set forth, it passes to the tonguing and grooving apparatus, located between the pairs of rollers *B*, *B'*, and *C*, *C'*.

The tonguing cutters are secured to the stock *Q*, *R*, *S*, and the grooving cutters in the stock *T*; which stocks are confined to the supporters *P*, *P*, in such a manner that they can be adjusted to any desired position by means of retaining screws, passing through the said stocks and through grooves in the supporters.

The stock *Q*, being held by the screws *j*, on which are nuts at the rear side of the supporters; and the stock *T*, is held by the screws *d'*, *d'*, and the nuts *e'*, *e'*, as shown in figs. 1, 2, and 3.

At the forward end of the plate *Q*, of the stock *Q*, *R*, *S*, there are placed the reducing knives *U*, *U*, in an auxiliary adjustable stock *S*; which auxiliary stock is connected to the plate *Q*, by the fulcrum bolt *n'* on which it vibrates. A screw *g'*, passes down through a lip that projects from the front end of the plate *Q*, into a tube *z*, in the front end of the auxiliary stock *S*, in which is located a spring for the said screw to bear upon; which enables the knives in the said stock to adapt themselves to boards of different widths.

From the face of the plate *Q*, spring the projections *o*, *o*, the extremities of

which are jointed to an accurate line with each other, and their front surfaces are all brought to the same angles of inclination—say, about forty-five degrees. The plate *R*, forming a part of the stock *Q*, *R*, *S*, has projections *o''*, *o''*, springing from it, which correspond in shape with the projections *o*, *o*, save in their being of less width.

A plate, *s*, accurately jointed and smoothed on both sides, and brought to exactly the thickness of the tongue to be formed on boards or planks, is placed between the projections *o*, and *o''*, of the plates *Q* and *R*, and the three plates are firmly united to each other by the screws *x'*, *x'*. Fluted rollers *t*, *t*, which have cutting edges *r*, *r*, radiating from their inner ends, are placed opposite each other against the plate *s*, and are secured to each other, and to the plate (*s*), by the screws *u*, *u*, and the nuts upon the same.

The inner sides of the cutting edges *r*, *r*, bearing closely against the plate *s*, and their peripheries projecting below the edge of the said plate, a suitable distance for cutting the sides of the tongue to be formed upon a plank. The knives *v*, *v*, are placed on opposite sides of the centre plate *s*, against the front inclined surfaces of the projections *o*, *o''*, and they are held securely in their places by means of the gibs *p*, *p*, and the set screws *q*, *q*; which act as follows, viz: the said gibs (*p*, *p*), pass into flaring slits in the centre plate *s*, and consequently as they are driven down into these slits, their rear surfaces are made to press the cutters against the front sides of the projections *o*, *o'*. The gibs *p*, *p*, have lips at their ends of corresponding shape, and when the set screws *q*, *q*, which pass through the lips at the front ends of the said gibs, are so turned as to cause their inner ends to bear against the outer edges of the knives *v*, *v*, on the front side of the centre plate *s*, they press the inner edges of the said knives firmly against the centre plate, and by the same movement cause the lips at the rear ends of the gibs to draw upon the knives *v*, *v*, on the rear side of the centre plate [*s*], and force their inner edges firmly against the said plate.

It will therefore be perceived that the centre plate *s*, serves as an unerring guide to the proper positions of the rotating and stationary knives, and the fluted roll-

ers which act conjointly with each other in forming a tongue upon the edge of a plank.

The reducing, edging cutters $\bar{u}$, $\bar{v}$, prepare the edge of a plank for the action of the tonguing cutters: when the edge of a plank comes in contact with the sharp edges r , r , and the fluted rollers t , t , they

are made to rotate as the sharp edges, cut into the edges of the plank on each side of the centre plate *s*, and the fluted rollers bear upon the plank, just in front of the stationary knives *v, v*, which remove the wood between the incisions made by the said rotating sharp edges *r, r*, and the outer angles of the edge of

Fig. 6.

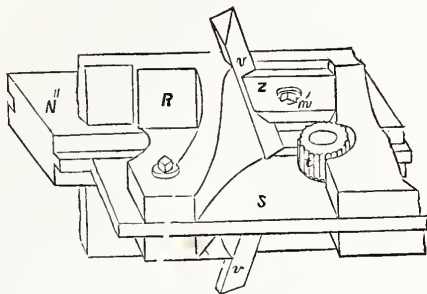
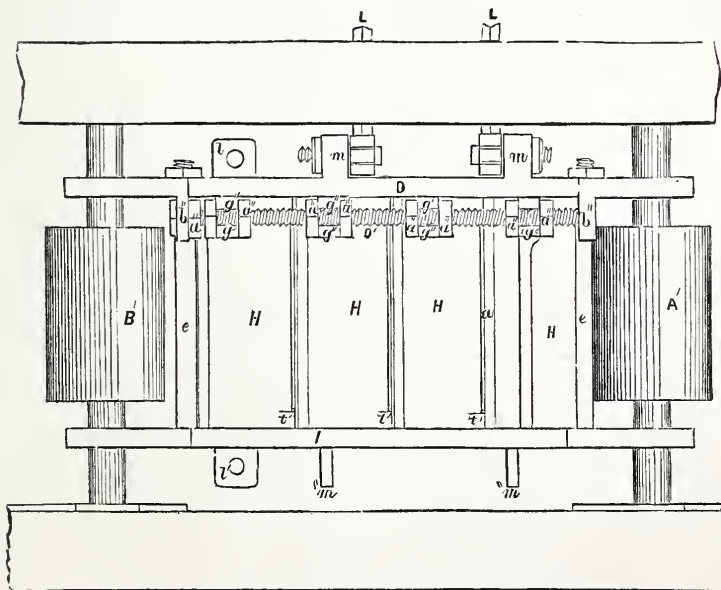


Fig. 7.



the plank. The said fluted or spur-rollers serving to break the fibre just in front of the edges of the said stationary knives, and prevent them from tearing splinters therefrom, in case the wood should be cross-grained, and also serving

as rotating mouth-pieces to the said knives.

The grooving apparatus which is combined with the stock τ_1 is arranged and operates as follows, viz.: the knife c' , the cutting edge of which projects above

the upper side of the stock *T*, smoothes the edge of a plank, preparatory to its being operated upon by the grooving apparatus which is secured to the front surface of the said stock *T*, is brought to a perfectly straight and even surface; the grooving apparatus composed of the several fluted rollers *x, x*, having cutting edges radiating from their ends, and the stationary cutters *y, y*, are then secured to the said smooth surface of the stock, in the manner shown in figs. 1 and 3, viz.: each fluted roller is secured by a screw *a'*, the shank of which forms the journals for the roller to rotate upon; each stationary knife *y*, is secured by means of a triangular piece *f*, (which is bolted to the face of the stock) in conjunction with the angular gib *b'* and the conical headed screw *z*; the rear side of the knife bearing against the front edge of *f*, and the gib *b'*, being pressed against the front side and the outer edge of the said knife (*y*) by the conical headed screw *z*, forces the inner edge of the knife firmly against the face of the stock, and its rear side firmly against the front edge of the projection *f'*. The cutting edges at the inner ends of the fluted rollers *x, x*, bear closely against the front side of the stock *T*, and the peripheries of the said rollers, and the cutting edges at their ends, as also the cutting edges of the stationary knives *y, y*, project a sufficient distance above the upper edge of the stock to enable them to form the requisite depth of groove in a plank.

When the edge of a plank comes in contact with the fluted rollers *x, x*, and the radiating cutting edges at their extremities, it imparts a rotary motion to them whilst they are acting upon the same, viz.: The said rotating cutting edges making incisions into the edge of the plank, and thereby forming the sides of the groove perfectly clean and smooth; and the fluted rollers bearing upon the edge of the plank, immediately in front of the edges of the stationary cutters *y, y*, serving as rotating mouth-pieces thereto, and also serving to break the fibres of the wood between the incisions made by the rotating cutters, preparatory to the removal of the same, by the said stationary cutters.

To enable the stationary cutters *y, y*, to make more perfect angles at the bottom of the grooves, and to discharge

their shavings more freely, I make their faces and cutting edges slightly concave, as shown on Fig. 3. It will be perceived that the face of the stock *T*, serves as an unerring guide to the proper adjustment of the grooving apparatus.

Suitable guides or fences for keeping the planks in proper position whilst being operated upon by the tonguing and grooving apparatus, must be provided, but it has not been deemed necessary to represent it, for the reason that the proper construction and arrangement of such guides or fences will be perfectly obvious to all machinists.

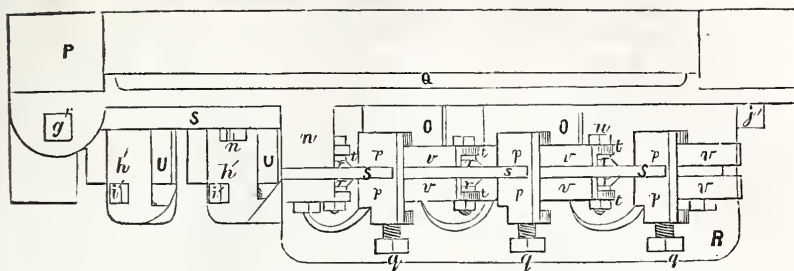
Fig. 6 represents a different shape and arrangement of the stationary tonguing knives *v, v*; in this arrangement, the cutting knives are of a triangular shape, and rest upon the plate *x*, with their ends bearing against the centre plate *s*; and they are secured in their positions by the gibs *z*, and set screws *m'*. The acute angle at the junction of the two sides of each of these knives forms their cutting edges, and they may be arranged at right angles with the centre plate *s*, or at any other angle that may be preferred. This plan of arranging the stationary tonguing, cutting knives, renders them less liable to clog with green lumber, than any other known method. *n''*, is the plank, showing its relative position to the cutters; the centre plate *s*, both in this and the former plan, bears upon the end of the tongue, and forms a guide for its width and depth through the whole series of cutters.

The plane stocks *G, G*, and *H, H*, may be so arranged as to pass obliquely across the face of the planks operated upon, if deemed preferable.

First, the jointing or hinging of the plane stock supporting frame *E, J, f, f*, or its equivalent at one end, and giving it an elastic bearing at its opposite end, substantially as herein set forth; whether the said plane stock supporting frame be used in connection with individually vibrating plane stocks, or with other descriptions of plane stocks or planing knives or cutters, for the purpose of reducing or planing planks or boards upon their sides or edges.

Second, the combination of the supporting frame containing the adjustable stocks *H, H*, with the self-adjusting supporting frame, containing the plane stocks

Fig. 8.



G, G, by which the inner or under surfaces of the plane stocks G, G, are made to form a self-adjusting bed on one side of a plank, whilst the knives in the stocks H, H, are operating upon and facing the opposite side of the same, and by which the inner or under surfaces of the plane stocks H, H, are made to form an unyielding bed, on one side of a plank, whilst the knives in the plane stocks G, G, are operating upon, and reducing its opposite side, and by which a plank can be faced on one side, and reduced and faced upon its opposite side at simultaneous operations, substantially as herein set forth.

Third, the combination of the supporting frame, containing the self-adjusting plane stocks G, G, with the arbor of the roller A, and its forward end, and with the supporting frame containing the plane stocks H, H, at its rear end, for the purpose, in the first place, of guiding the transversely reciprocating movements of the said plane stocks supporting frames, as to keep the inner sides of the respective series of plane stocks contained therein parallel with each other, and parallel with the surfaces of the pairs of rollers A, A', and B, B'; and in the second place, for the purpose of enabling the supporting frame containing the self-adjusting plane stocks G, G, to be detached from the supporting frame containing the adjustable plane stocks H, H, and be swung outwards upon the shaft of the roller A, to afford free access to the inner sides of the plane stocks in both the said plane stock supporting frames, substantially as herein set forth.

Fourth, the combination of the rollers d, d, with the plane stocks G, G, when

they are so arranged that the roller in one plane stock will form a rotating and self-adjusting mouth-piece to the planing knife that succeeds it, and at the same time form a bed on one side of a plank for a planing knife acting upon its opposite side, substantially as herein set forth.

Fifth, the giving to straight edged planing or reducing knives or cutters, that are arranged athwart the surfaces of the boards or planks operated upon a transversely reciprocating movement, whilst a continuous longitudinal movement is imparted to the said board or planks.

Sixth, the manner of producing a uniform elastic pressure upon the upper and lower bearing boxes of the arbors of the pressure rollers A, B, C, viz.—by means of pairs of screws k, k, arranged as herein described, and having threads inclining at angles of about thirty degrees, with their axes, which are banded together and operated upon by a weight (N) substantially as herein set forth.

Seventh, the within described improved stock that receives the tonguing cutters v, v, and r, r, composed of the central governing plate s, combined with the projections o, o, on the side plate q, and the projections o'', o'', on the side plate R, substantially as herein set forth.

Eighth, the manner of combining the stationary cutters v, v, with the governing centre plate s, by means of the inclined projections o, o'', on the sides of the said plate, the flaring notches in the plate, and the gibs p, p, having lugs at each extremity, placed in the said flaring notches, and acting upon the edges and front sides of the said cutters v, v.

ROBERTSON'S IMPROVEMENT IN MANUFACTURING SHEET-LEAD.

From the Specification of the Inventor, John Robertson, of Brooklyn, New-York.

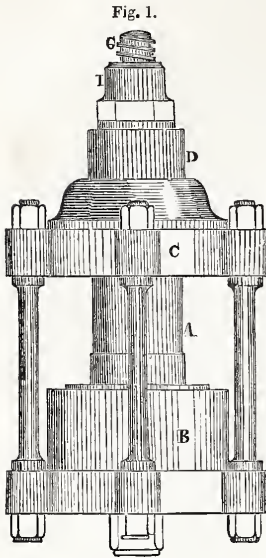


Fig. 1.

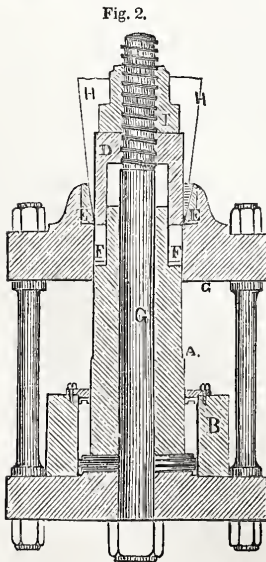


Fig. 2.

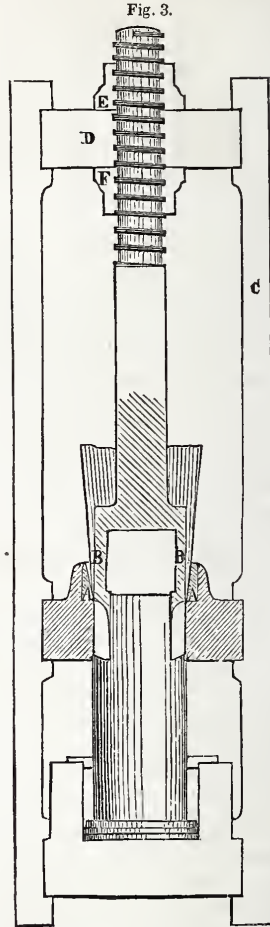


Fig. 3.

Fig. 1 is an outside view of the machine; fig. 2 is a section; and fig. 3 a modification of a machine for the appli-

cation of the attachment hereafter specified. Fig. 2 is a sectional view of a hydraulic press and sheet-lead machine, A, being the water-ram, B, being the water-cylinder, C, the top, G, machine with the lead-chamber, F, with interior die E, for the purpose of thickening the sheet-lead, G, being a strong wrought-iron bolt fixed to the bottom of press and passing through the water-ram for the purpose of resisting the pressure and holding and regulating the interior die, H, represent-

ing the sheet of lead pressed out from the lead chamber. But in machines at present known and used, each time it is required to produce sheet-lead of a different thickness, a new die is required to replace the former, and thus a die is required for every thickness of sheet-lead, causing great expense and much labor and time in changing them in a machine which must necessarily be so ponderous in a manufacture of this description, where the dies must be over two feet in diameter.

Now, the manner in which I accomplish the manufacture of the various thicknesses of sheet-lead in contradistinction to this, is as follows: The interior die, *D*, being placed on the iron binding bolt, *G*, is adjusted by screwing it up or down on this bolt, and farther secured in its proper place by the thick nut, *I*, on the top of the bolt, *G*, and at the exit of the sheet from the lead chamber, *F*, is placed the exterior stationary conical die, *E*: thus completing my invention, from which it will be easily seen, that by depressing the interior cylindrical die at any determined height on the bolt, *G*, by means of the adjusting screw, the annular opening or distance from the interior and exterior dies will be increased or diminished. Thus, the closer the interior die is placed down to the lead chamber, *F*, the annular opening for the sheet of lead is made smaller, producing a thinner sheet; and the farther it is placed from the lead chamber, or near the top of the exterior die, *E*, the annular opening will be increased, producing a greater thickness of sheet lead. The annular sheet of lead is slit or cut by a cutter in the exterior die, as the lead passes through, and is opened up, and received and rolled up on a roller.

Fig. 3 is a different arrangement of a similar machine, containing the adjustable interior cylindrical die, and the stationary conical exterior die, *A* and *B*, by which means the lead is pressed out in the same manner as before described; but the interior adjustable cylindrical die, *B*, instead of being fastened to the bolt, passing through the water-ram and fixed to the bottom of press, as before described. The framing of press, *C, C*, is extended upwards, for the purpose of holding the press-top, *D*, in which the interior adjustable cylindrical die, *B*, is fixed

and adjusted by the check-nuts, *E*. Fig. 3, is represented, not for the purpose of claiming the construction of this press, but simply to show the application of the dies, as before described, to a press of this construction.

I claim the adjustable interior cylindrical and the exterior stationary conical dies in combination and for the purposes described, irrespective of the precise manner in which they are applied, or by which the adjustment is effected.



IMPROVEMENT IN SELF-ADJUSTING RAILROAD SWITCH.

From the Specification of the Inventor, John C. Past, of Whitehaven, Pa.

Fig. 1 is a perspective view of a Railroad and Locomotive, representing one of the forms in which my improvements may be applied, and is not intended so much to represent an exact view of my improvements, as a general view of the action of the whole combination. Fig. 2 is a top view or plan of the road, in which the position of the various parts is correctly delineated. Fig. 3 is a side elevation, showing the relative position of the counterpoise weights; and Fig. 4 an enlarged view of the counterpoise weights, a section of the movable rails or treadles, and the relative position of the arms of the rock shafts and the counterpoise weights. Fig. 5 is another arrangement which may be used in place of the one herein described.

The nature of my invention consists in providing certain counterpoise weights or counterbalances (or their equivalents) upon the rock shafts, on which the movable rails or treadles act, in combination with toggle levers, arranged with the other parts of the contrivance as hereinafter described, so that a secure lock to the switch, when moved into the desired position, is established and maintained, thereby rendering it not liable to be displaced by the oscillation or jarring of the cars, and a switch is produced which can be operated or shifted with certainty by the weight of the cars. The object accomplished by the counterpoise weights is the forcing of the toggle levers a little over the centre, and against the stops *Q, Q*, in which position they form the lock upon the switch, for after the cars have

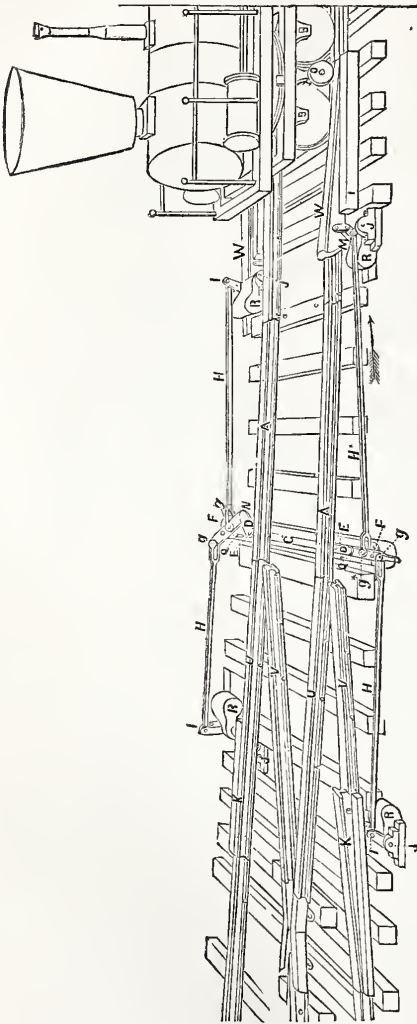
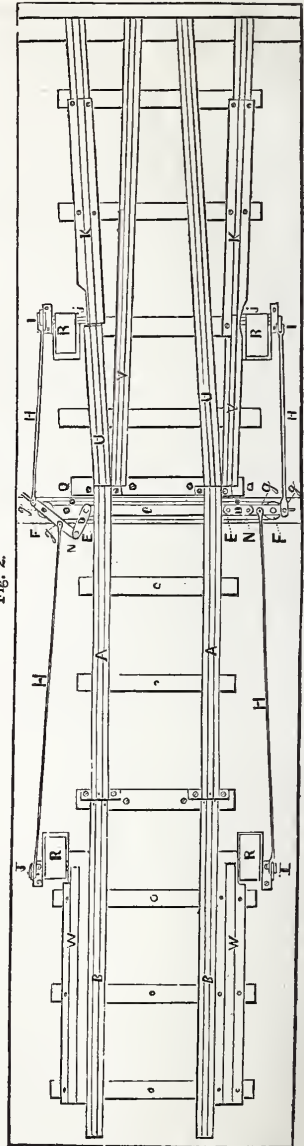


Fig. 2.



passed over the treadles or movable rails, if it were not for the counterpoise weights there would be a spring or reaction which would throw the toggle lever out of position, and destroy the

whole security of the machine, by rendering the switch liable to displacement by the oscillation of the cars.

The switch A, and the tracks B, U, and v, are made in the usual manner; but J

have found from experiment that it is the best manner of constructing my self-adjusting switches, to connect the rod c, of the switch at each end to a toggle lever of the form exhibited at D, D, which toggle levers turn upon their fulcrums F, F, freely, said fulcrums being securely attached to the main bed timber or tie, in such positions as just to admit of the switch moving the proper distance while the toggle is moving from a right line into the angular position it assumes when the other toggle is in line.

To the outer or long arms of the toggle levers D, D, are united by joints or hinges at g, g, g, g, the connecting rods H, H, H, H, which extend to the arms I, I, I, I, of the rock shafts J, J, J, J, to which rock shafts the counterpoise weights are attached; the other arms M, M, M, M, are connected with the movable rails or treadles w, w, K, K, by links or connecting plates. The arms I, I, I, I, and M, M, M, M, of the rock shafts are set at right angles to each other, so that when the arm I, is vertical, the arm M, of the same shaft will be horizontal, and the connection with the treadles and toggle levers are so arranged that the arms I, I, I, I, vibrate in arcs about equal on each side of a vertical line, and the arms M, M, M, M, in arcs about equal on each side of a horizontal line. The counterpoise weights are attached to the rock shafts on the opposite side of the arms M, M, M, M, at an angle of about twenty degrees above a line drawn through the arm M, across the centre of the rock shaft, and continued as shown in Fig. 4, by the red dot line, and are of sufficient weight to somewhat more than neutralize the tendency of the treadles to depress the arms M, M, M, M, by their gravity, the effect of the angular position of the counterpoise weights being such, that they are horizontal, and exercising their greatest force when the toggle lever with which they are more directly connected is nearly upon its centre, or in a right line, and the power applied (upon the opposite side of the road) is insufficient to move it into its proper position. The bearings of the rock shafts rest in pedestals securely attached to a part of the timber frame on which the whole machine rests, and to which the principal cross sills of the road are united.

Since the parts connecting the treadles

with the toggle levers are all similarly arranged, a description of the action of one part will answer for the others also.

Now, by a careful inspection of the arrangement of the several parts, as combined in the accompanying drawings, it will be perceived that the treadle w, will press with about one-half its weight upon the arm M, of the rock shaft J, and that this pressure, if it were not counteracted by the gravity of the counterpoise weight, would tend to draw, in the direction of the arrow, (Fig. 1) upon the arm I, the connecting rod H*, and the toggle lever D*, at g*, precisely in the same manner as when the treadle w, is pressed upon by the weight of a car or locomotive, and hence would tend to draw the toggle lever from its position against the stop, and thus unlock the switch, because the lock depends upon the toggle resting against the stop, or in line. The object of the lock being to prevent the oscillation of the cars in passing over the switch from displacing it, as hereinbefore stated.

To illustrate the operation of the switch we will suppose a train approaching in the direction indicated by the Locomotive Fig. 1. When the guide wheel o, runs upon the treadle w, it will depress it, this again will depress the outer end of the arm M, of the rock shaft, and communicate a rotary motive to the shaft, this causes the outer end of the counterpoise weight to rise, and the arm I, to move in the direction of the arrow, carrying with it the connecting rod H*, which by this means draws the toggle lever D* into the angular position, and the switch into line with the tracks v, v, and causes the toggle lever D to straighten, and here the counterpoise weights upon that side of the track come into action, and not only assist in lifting the treadles, but by means of their pressure through the medium of the connecting rods upon the toggle D, push it against the stop q, and hold it there until pressure is applied to the treadles upon that side of the road, when the same operation is repeated in an inverse direction.

The parts of the switch not hereinbefore described, may be constructed as described in letters patent No. 1294 granted to me, and dated August 21st, A. D., 1839.

By having thus described what I con-

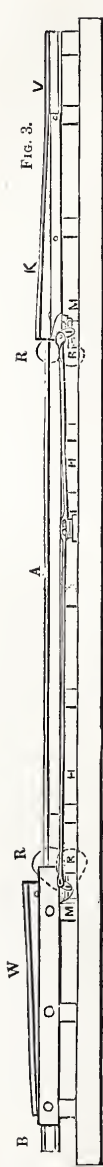


Fig. 3.

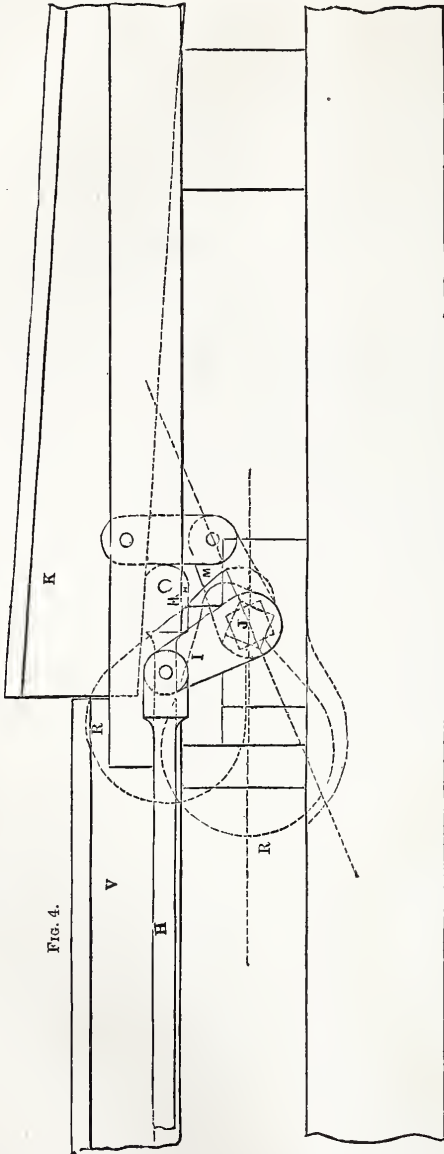


Fig. 4.

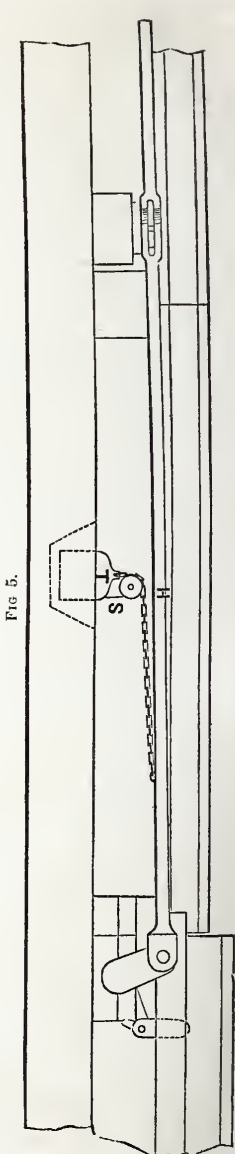


Fig. 5.

sider the best mode of constructing a self-adjusting Rail Road Switch, I do not mean to limit myself to this particular form or manner of applying my

invention, on the contrary I have various modes of effecting the same object. For example, a chain may be attached to the connecting rod H, Fig. 5, and thence ex-

tend parallel to it in the direction of the toggle lever, a distance equal to or greater than the motion of the rod, and then fall over a pulley having its gudgeons in the uprights, to the end of which chain is attached a weight *T*, heavy enough to retain the toggle against the stop, or a chain and weight, or similar device may be attached directly to the toggle lever near the angle, and carried over a roller immediately behind the stop. Now as the tendency of the weights would be to throw the toggle levers too far, it is necessary to provide some means of stopping them at the proper place, and this I effect by means of a pin *Q*, or other like device, placed in such position as to arrest the motion of the toggles as soon as they pass the centre. Or the toggles may be rube-jointed to effect the same purpose.

I claim the combination of the counterpoise weights *R*, *R*, *R*, *R*, or their equivalents, with the toggle levers *D*, *D*, and stops *Q*, *Q*.



CAST IRON CAR WHEELS. IMPROVEMENTS
OF ISAAC VAN KURAN OF BOSTON, MASSA-
CHUSETTS.

From the Inventor's Specification, patented May 20,
1851.

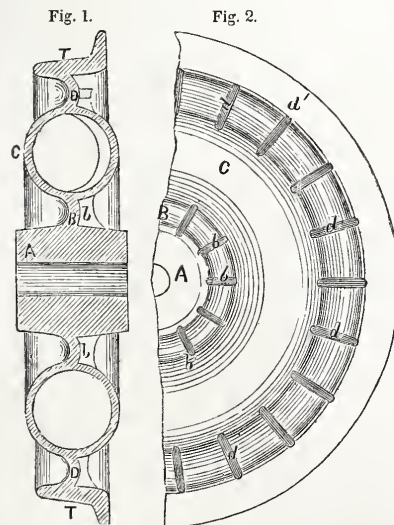


Figure 1 is a front view or elevation of the wheel.

Figure 2 is a vertical transverse sec-

tion taken through the middle of the wheel.

The same letters refer to like parts on the said figures.

The nature and object of my invention is the construction of a cast iron car wheel which will combine strength of form with great lightness of materials; and for this purpose I cast the wheel with a solid hub, and join the said hub to the tread by a curved plate next to the hub, which plate is strengthened by curved outside braces, then a circular tube running round the face of the wheel, and then a curved plate joined to the said tube and the tread of the wheel.

The outside curved plate is also strengthened in such a manner that the curved braces on the inside curved plate next the hub branch out so as to be opposite the space between the outside braces.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction.

A is a solid hub; B is a curved solid iron plate, one side of which (the outside) is convex, and the other side concave—around this plate are cast curved braces *b b*; *c* is a tube cast around the wheel, and situated about midway between the solid hub A and the tread of the wheel. D is another curved, solid plate, formed exactly like the plate B. It also has curved metal braces *d d* cast on it. These curved braces are formed like the braces *b b*, but their terminating sections outside at *d'* project in a different direction from that of the terminating section *b'* of the inner braces *b*. If the inside curved braces branched out to the tread continuing their form as joined with the outside curved braces *d*, each whole brace would present a form on the side of the wheel like an *s* brace,—a most excellent form for strength. This, however, could not be done without weakening the whole wheel, for the braces would then be very wide apart at the outside, just where the greatest strength is wanted. To retain the *s* form of the braces, and compensate for the distance they would be apart at the outside, I place just double the number of braces *d* on the wheel that there are of those marked *b*, so as to have the inside tier of braces (each brace) project outwards towards the spaces between the outside braces.

There are two desirable objects to be obtained in the cast iron railroad car wheel; one is lightness of metal, combining a good form for strength; and the other is a good form in every part for casting. I do not say that the present form of wheel herein described is of a better form for strength than the wheel patented by me May 1st, 1849, nor do I think it is quite so good, but it combines rather a better form for casting, and contains to the same diameter about thirteen pounds less of metal, which enables the wheel to be sold at a less cost, this being an advantage more in favor of the buyer than the seller; and a wheel certainly meets all that is demanded of it when it has been tried and found to be perfectly adapted to its specific object. This wheel now described I have faithfully tested, and some of the kind are now in actual use, and give every satisfaction, both as it respects durability, strength, and lightness. In casting wheels there is much difficulty experienced in the shrinkage of the metal when in the act of cooling; this is the fruitful cause of waste in castings by breakage. A bad form of wheel for casting, although it may be a strong form, is of doubtful utility; because there may be many unseen flaws which do not develop themselves until the wheel is on the car, and running, when at once the centrifugal force separates the parts that have flaws in them from the sound parts, there is a break down, and perhaps a serious accident. This form of wheel is a very excellent one for casting, so as to make all the parts shrink together in cooling in such a way that the thinner portions of the metal have some compensating qualities combined with them.

The hub being the thickest part of the metal, it will not shrink altogether as fast as the other parts, but then by its core being taken out, the interior can be cooled in such a way along with the outside as to make it shrink altogether about the same time that it requires the curved plates *B*, with their braces, to shrink.

The pipe or tube *c*, being thin, it can be tempered in the cooling by keeping the core in until all is cool. The tread can be cooled as desired, it being on the outside. I find, however, that this form of wheel cools with great uniformity, therefore the shrinkage is equalized, and

good castings are uniformly the result. Its qualities in the respect stated, I believe, are superior to any other wheel in use.

I claim a cast iron railroad wheel constructed with the solid hub *A* and the tube *c*, the said tube being united to the hub by a curved plate *B*, with curved projecting braces *b b* on it, and connected to the tread *T* by a curved plate *D*, with the curved braces *d d* on it.

We add the specification and description of the car wheel of Albert Hebbard, of Worcester, Massachusetts. This is also patented at the same date as the last, viz., 20th May, 1851.

Figure 1 denotes a front elevation, Figure 2 a rear view, and Figure 3 a central and transverse section of my improved wheel.

It is well known that much difficulty has been experienced in producing by the operation of founding, an entire cast iron railroad wheel having a chilled rim, various forms or patterns having been devised for such purpose.

It has been found that most of what are termed the plate or double plate wheels, or those in which the rim and hub are connected together by one or more curved plates or discs, are liable to fracture at the rim or tread when under very high velocities and running upon a railway. I would remark, that, in order to overcome the disastrous effects liable to be produced by contraction of the metal of the plates, during the process of casting, they have been made with concentric undulations, extending between the hub and rim, such undulations producing a serpentine curve in the section of the plate, provided such section be taken in a radial plane from the hub to the rim. Undulations or curves so arranged, have a tendency to greatly weaken the plate in radial directions. A wheel constructed with straight spokes is generally considered as better adapted to withstand shocks, than one having curved spokes. It has been considered exceedingly difficult if not impossible to cast a *straight spoke* wheel, with a chilled rim, and a solid or undivided hub. In order to produce such, it became necessary to split or divide the hub into sections, thereby not only

FIG. 3.

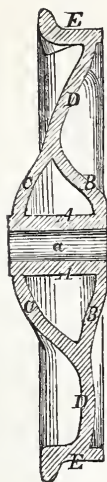


FIG. 1.

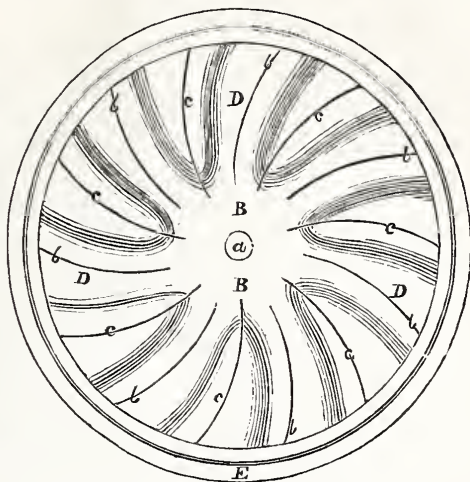
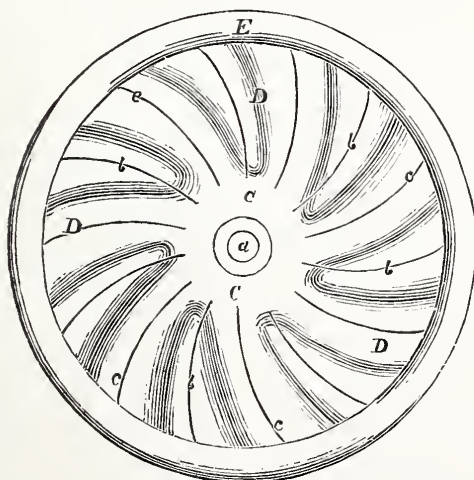


FIG 2



greatly weakening it but requiring much labor and expense to prepare it for the axle.

There are some disadvantages attending the "double plate" wheel, one of which is, that in order to ensure the required strength to the plates, it becomes necessary to put into both of the plates much

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more metal than would be required in a solid form in one plate.

My improved wheel has a combination of the single plate and the double plates between the hub and the rim. Besides it has the advantage of not only a solid, but what is usually termed an undivided hub. In the drawing, A represents the

hub, which is a solid cylindric tube of metal, extending through the wheel. It may, however, be separated into two parts transversely of its axis if desirable, but as this weakens the hub, I prefer to cast it solid, or in one entire piece, excepting the hole *a* through it for the reception of the axle. From the two ends of this hub two plates or discs *B*, *C*, extend together in a serpentine line or joining, or with a single plate *D*, to which a corresponding serpentine form is given entirely around, or concentric with the hub, the curved sinuosities of said plate increasing in size from the joining of it with the plates *B* *C* to the rim *E*, as seen in the drawings. I would remark, also, that the convexities and concavities of the serpentine plate *D*, are curved from the centre towards the rim of the wheel, in radial directions as denoted by the red lines *b*, *b*, *c*, *c*, in figures 1 and 2. The serpentine plate *D*, at its connection with the rim has a waved or serpentine joining, such as insures strength to resist both vertical and lateral shocks. The tread of the rim is founded against a chill in the usual way, and the wheel cast at once in one entire piece.

I claim the above described improvement, or wheel made with a chilled rim either a solid hub or one divided crosswise of its axis, two plates or discs *B*, *C*, united in a serpentine curve at their outer peripheries, a third plate *D*, not only made serpentine concentrically with the hub, but curved in radial directions as described, all cast, or founded and combined together in one piece.



FAIRBAIRN'S IMPROVEMENTS IN MACHINERY, FOR PREPARING, SPINNING, AND WEAVING COTTON, FLAX, AND OTHER FIBROUS SUBSTANCES; ALSO IN CONSTRUCTING AND APPLYING MODELS, OR PATTERNS, FOR MOULDING, PREPARATORY TO CASTING PARTS OF MACHINERY, EMPLOYED IN PREPARING, SPINNING, AND MANUFACTURING FIBROUS SUBSTANCES; AND ALSO IN CERTAIN TOOLS TO BE USED IN MAKING SUCH MACHINERY.

This specification relates—First—To Improvements in the arrangement and construction of scutching, opening, cleaning, and lapping machines, employed in

the preparatory processes in the manufacture of cotton, flax, and other fibrous materials.

Secondly, To the arrangement and construction of certain parts of drawing frames, likewise employed in the preparatory processes of the manufacture of fibrous materials.

Thirdly, To the arrangement of the driving parts of throstle frames, employed in the spinning of cotton, and other fibrous materials.

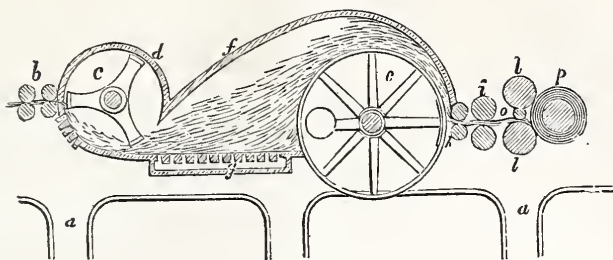
Fourthly, To the arrangements and construction of certain parts of looms, employed in the manufacture of textile fabrics.

Fifthly, To the moulding for casting in iron, brass, or other metal,—parts of machinery employed in the manufacture of fibrous materials.

Sixthly, To the construction of certain tools and machines, employed in cutting and shaping parts of machinery.

The improvements described under the first of these heads, consist—First. In a means of spreading and distributing the opened and cleansed fibres of the material, thrown from the beaters of opening, scutching, and lapping machines, more even and uniform, than is now done by the ordinary constructions of machines employed for those purposes. Secondly. In an arrangement of the position and mode of action, of the lapping and calendering rollers, whereby the sheet of lapped fibrous material is more compressed when wound upon the lap roller. These two improvements are shown in the accompanying engraving, fig. 1, which represents a sectional elevation of a lapping machine: *a*, the framing of the machine; *b*, the ordinary feeding rollers, to which the fibrous materials to be operated upon, is fed by hand by any of the modes now adopted and employed; *c*, the beater, which is likewise of the ordinary construction; it is enclosed above by the case *d*, and beneath by the grating and plate, over which the fibres of the material are driven from the feeding rollers by the rapid revolving movements of the beaters; *e*, the perforated cylinder or drum, upon the periphery of which the fibres of the material are collected and formed into a lap. The interior of the cylinder is partially exhausted of air, so as to produce a partial vacuum within, and thus attract the fibres of the material

Fig. 1



to its periphery; *f*, the portion of the casing or shield above the perforated cylinder and the grating, *g*, under which the fibres pass from the beater to the perforated cylinder; by the shape and curvature of this shield or casing the fibres are more diffused, and better and more evenly collected and spread upon the surface of the perforated cylinder, than by the usual construction of lapping machines.

The next improvement, which is the arrangement of the lapping and callendering rollers, is likewise illustrated in fig. 1. The accumulation of fibres upon the surface of the perforated cylinder *e*, forming the lap of the material, is taken off by the rollers *h*, hence the lap passes between the large pair of callendering rollers *i*, and onward to the lapping rollers *l*, *l*, passing between the lower of these rollers and the small callendering roller *o*. The upper of the lapping rollers *l*, rests upon, and is supported by, the small callender roller *o*, by which the lap of fibrous material, passing between it and the lower lapping roller, is compressed; the lap then passes to the lap roller *p*, around which it is coiled or wrapped. In the ordinary construction of these descriptions of machines, the lap roller *p*, is placed above the two lapping rollers, resting upon both of them; but by this mode of arrangement and working, the lap, in passing from between the lapping rollers to the surface of the lap roller, is distended, and consequently, when wound upon the lap roller, is not in so compressed a state as is most desirable; for this reason, the present patentees propose placing it horizontally, in respect to the lapping rollers, and applying the small callender roller between the two lapping rollers. The

effect of this mode of working is, that the lap is less distended, and consequently wound upon the lap roller in a higher state of compression than by the usual method, for the purpose of maintaining the surface of the lap roller always in contact with the surfaces of the lapping rollers, the bearings carrying the axis or shaft off. The lap roller is mounted upon a traversing frame or carriage, sliding upon the framing of the machine, in a direction horizontally to and from the lapping rollers. Pendant balance weights, attached to cords or chains, passing over pulleys, act upon the traversing carriage, tending always to draw it towards the lapping rollers, and thus maintaining the surface of the lap roller in contact with the lapping rollers, the gravity of the balance weight determining the pressure. The axis or shaft of the lap roller is mounted in slots in the carriage, and have antifriction rollers placed behind them in the bearings, for the purpose of having as little friction as possible acting against the rotation of the lap roller, as that roller is turned by surface contact only with the lapping rollers.

The improvements described under the second head, relating to drawing frames, consist—

First—In the adaptation and application to those machines of a falling weight, and its actuating apparatus, for the purpose of stopping the further motion of the machine, whenever a definite or required quantity of sliver is received from the machine into the can.

Secondly—In the arrangement of the small cylindrical roller gills, described in the specification of a patent granted to Messrs. Fairbairn and Carmichael, and dated October 2d, 1846, by providing them with flanges, and also in arranging

several sets of gills and drawing rollers in each machine.

The first of these improvements consists as follows:—Upon the lower back drawing roller shaft a worm is cut, this gears into, and gives motion to a worm wheel revolving on a fixed stud, projecting from the frame of the machine; upon the boss of this worm wheel another worm is cut, gearing into, and giving motion to, another wheel, also revolving upon another fixed stud; upon the boss of the second worm wheel a worm is likewise cut, so that as the drawing rollers revolve, a slow motion is communicated through the two worms and worm wheels to the last worm. An adjustable guide frame is attached to the framing of the machine, the sides of which project upwards on each side of the worm.

The object of this is, that when a loose weight is placed to rest upon the worm, it shall be retained and prevented from falling off by the sides of the guide. This weight is cylindrical, and has a worm or screw cut upon its surface, the pitch and thread of which corresponds with that of the worm upon the boss of the wheel; so that as the last revolves from the drawing rollers, it will gradually traverse the loose weight along it towards one end, until the weight so overhangs the end of the worm, that the gravity of it causes it to fall from the worm, when it will be received into a small box beneath; this box is fixed upon one end of a balanced lever, the other end of which communicates with the usual sliding bar of the stopping apparatus; when the loose weight falls from the worm into the box, that end of the lever will then preponderate, and lift the other end into one of the notches in the sliding-bar, and thus, through the bar, stop the further movement of the machine; the time of the falling of the weight will depend upon the distance from the end it may be placed upon the worm. This is regulated by the adjusting guide frame, so that by adjusting the situation of the guide, and then placing the loose weight up to it, when an empty can is placed in the machine, any determinate quantity of sliver may be delivered into it, and when that quantity is delivered, the loose weight will fall and stop the movements of the machine, as before described.

The improvements in roller gills, consist in the application to those descriptions of cylindrical gills having needle points of flanges, one on each side.

The object of this improvement is for the purpose of confining the sliver of fibrous material, as it passes the gills, to the surface width of them, by which the whole of the fibres composing it will be operated upon by the teeth.

The other improvement respecting gill machinery, consists in adapting and employing two or more gills, and their accompanying drawing rollers, in one machine, the slivers of fibrous materials being successively acted upon by them, as they pass through the machine,—thus performing in one machine what now, by the usual method, requires several machines to accomplish.

The improvements in the mode of driving the spindles in throstle frames, described under the third head of the specification, consist in employing one band or cord only, to give motion to two or more spindles, on opposite sides of the machine. The band passes from the driving drum to and around the wharve of a spindle upon one side of the machine, then across to the wharve upon a spindle on the opposite side of the machine, around which it passes hence to and around a large drum or pulley, and back to the driving drum,—thus two spindles will be driven by one band.

The fourth part of this specification relates to the construction of certain parts of looms, employed in the manufacture of textile fabrics, and the first of the improvements described under it, consists in the adaptation to the loom of a break operating for the purpose of stopping the movements of the loom, when the ordinary spring lever is thrown from its notch by any means, and shift the driving strap from the fast to the loose pulley, as the release of the spring lever causes the break to come into contact with, and act upon the break wheel, and thereby quickly stop the movements of the loom, after the shifting of the strap. This improvement is illustrated in figure 2, which represents a front and side elevation of the break and upper end of the spring lever, as attached to the loom; *a* is the break or fly wheel, fixed upon the ordinary crank shaft of the loom; *b* is the ordi-

Fig. 2.

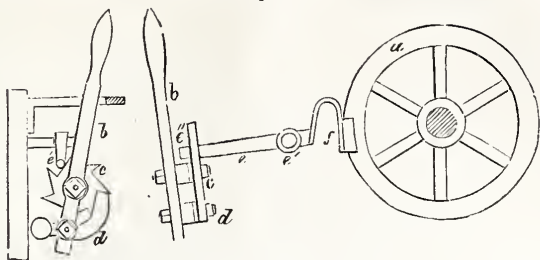
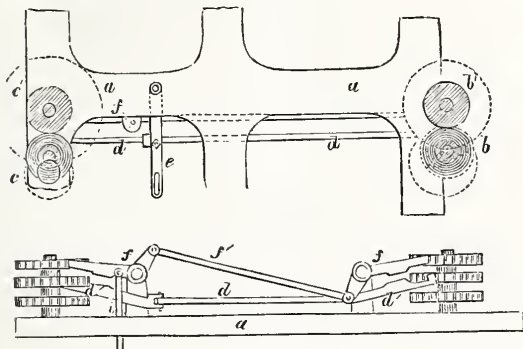


Fig. 3.



nary spring lever,—upon the lever is fixed a projecting pin or stud, which carries upon it the star wheel *c*, which is capable of revolving upon the stud; *d* is a weighted click, moving upon a projecting stud, likewise fixed to the spring lever, at a little distance below that carrying the star wheel; this click gears into the teeth of the star wheel, and prevents it from moving, except at the proper time; *e* is the break lever moving upon the fulcrum *e'*, which is a fixed stud projecting from the side framing of the loom,—the end of this lever nearest to the spring lever carries a pin or stud, *e''*, which, when the spring lever is in its notch, and the driving strap on the fast pulley, rests on one of the teeth of the star wheel, and the break *f* upon the other end of the break lever, will then be out of action with the break or fly wheel *a*. The apparatus is represented with the spring lever in its notch, and the loom at work. The action of this break apparatus is as follows:—The spring lever is thrown from its notch, by the action of the ordinary stop rod apparatus, or by any other means, and shifts the driving strap from the fast to the

loose pulley; the movement of the spring lever causes the tooth of the star wheel *c* to act upon the pin or stud *e''*, upon the end of the break lever *e*, and raising that end of the lever causes the break *f*, upon the other end of the lever to come in contact with, and act upon the periphery of the break or fly wheel, by which the further movement of the loom will be stopped during the traverse of the spring lever, the inclined edge of the tooth acts upon the pin *e''*, until it arrives at the top of the tooth, when it falls over and drops into the next tooth. The replacing the spring lever back again to its position in the notch, releases the break from contact with the break wheel, and brings the break lever back to its original position, by the star wheel moving round by the pin *e''*, pressing against the radial edge of the tooth, the weighted catch *d* allowing it to move round in that direction.

The patentee describes a modification of the above mode of actuating the break lever upon the release of the spring lever: this is by the employment of an inclined edge of a plate, instead of the in-

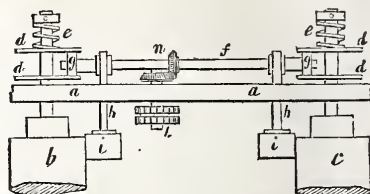
clined edge of the tooth of the star wheel ; this inclined edge is fixed upon the spring lever, and therefore the same edge actuates the break lever each time the spring lever is released, and not as before by each tooth of the star wheel in succession. In this modification, the pin or stud against which the inclined edge of the plate acts is attached to the break lever by a hinged joint, so as to move and allow the return of the parts to their original positions when the spring lever is replaced in its notch, the inclined plate being a fixture upon the spring lever.

The next improvement under this head consists of an arrangement of apparatus attached to the cloth loom for giving the required motion to the cloth beam, for taking up the fabric as manufactured, and also to the warp beam, for letting off the warp. This apparatus is illustrated in fig. 3, which represents an elevation and plan of part of a loom, showing the warp and cloth beams, and the mode of actuating them, which is by means of the vibration of slay swords ; *a, a*, the framing of the loom ; *b*, the warp beam ; and *c*, the cloth beam ; upon these beams, rollers, *b'* and *c'*, rest respectively ; these are connected by spur gearing to ratchet wheels, shown in dotted lines, and into the teeth of these ratchets, clicks, *d', d'*, gear ; these clicks are upon the ends of the longitudinal bar, *d* ; the bar is jointed to the pendant lever, *e*, moving upon a stud, fixed to and projecting from the framing, *a*, of the loom. The lower end of this lever is formed with slot, into which a pin, fixed to, and projecting from one of the slay swords passes, and as the slay sword performs its vibrations, it carries with, and gives motion to the lever, *e*, and thus, through the bar and clicks to ratchet wheels and rollers, *b'*, and *c'*, thus giving motion to the warp and cloth beams by contact with these rollers.

The next improvement described, is effecting the recoil or reversed movement of the warp and cloth beams whenever a false shot has been made ; this is likewise shown in fig. 3 ; it consists of two bell-crank levers, *f, f*, moving upon brackets fixed to the framing of the loom ; these are connected together by the diagonal rod *f'*, and the ends of the long arms of the levers are formed as clicks, and act upon the teeth of ratchet wheels

fixed upon the bosses, which move with the ratchet wheels, acted upon by the clicks upon the rod, *d*. These ratchet wheels have such an unequal number of teeth, that is, there are more teeth in one than in the other, and consequently, when the click is fully in gear with

FIG. 4.



one wheel, the click of the other will be midway between two teeth. A rod, *i*, is attached to one of the bell-crank levers ; the other end is arranged so as to move the rod when the recoil is to be affected. The mode of action is thus : when the recoil is required, the rod, *i*, is pulled, and this moves the bell-crank levers, *f, f*, towards the clicks *d', d'*, upon the ends of the rod, *d*. The levers, *f, f*, as also the clicks, *d', d'*, have each a lug or projection, and when the bell-cranks are moved towards the clicks, the lugs upon the levers come under those upon the clicks, and lift them up out of gear with their respective ratchet wheels. The ratchet wheels being now released, run back, or make the recoil for half the length of a tooth, when the clicks, carried by the bell-crank levers, gear to the next teeth upon their respective ratchets. Upon the starting again of the loom, the reversed movement of the bell-crank levers releases the clicks upon them from their ratchets, and allows the clicks, *d', d'*, to drop again into gear with their ratchets, and thus another recoil to the extent of another half-tooth is affected.

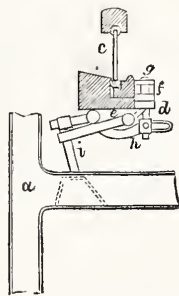
Another mode described of giving motion to the warp and cloth beams, is by the employment of frictional surfaces, by which the velocities of the two beams are regulated, as the diameters vary, by the unwinding of the warp, and the taking up of the fabric. This construction of apparatus is illustrated in fig. 4, which represents a plan view of the apparatus, as adapted to a loom ; *a*, the upper edge of the side framing of the loom ; *b*, the

cloth beam; and *c*, the warp beam. The axes of these are elongated, and continued through their bearings in the framing, *a*, and carry upon their outer ends the friction discs, *d, d*; one of these, upon each axis, is fixed upon it, and the other is loose. Helical springs, *e, e*, are placed upon the elongated parts of the axis of the two rollers, behind the loose discs, by the action of which these discs always have a tendency to approach towards the fixed ones. Upon the outside of the framing, *a*, is mounted the horizontal shaft, *f*, revolving on bracket bearings attached to the framing; the ends of this shaft carry the friction bowls or pulleys, *g, g*, which are capable of sliding longitudinally upon the shaft, but revolve with it by means of feathers, in the usual manner. To the bosses of the friction bowls, *g, g*, are attached the arms or levers, *h, h*, which pass through slots or guides in the framing, and carry upon their outer ends the rollers, *i, i*. The connection between the bosses and the arms or levers is such, that the bosses will revolve within the eyes of the arms. The rollers, *i, i*, bear by their peripheries against the surfaces of their respective beams, one against the cloth and the other the warp beam, consequently, the greater or less diameter of those beams will determine through the rollers, *i, i*, and the levers, or arms, *h, h*, the position of the friction bowls, *g, g*, in respect to the friction discs, *d, d*, further from, or nearer to their centres of motion. Motion is given to the horizontal shaft, *f*, from the crank or tappet shaft of the loom through the spur wheel, *l'*, and the bevil gearing, *n*. The operation of this machinery for regulating the letting off the warp from the warp beam, and taking up the fabric upon the cloth beam, is as follows: The loom being at work, a rotary motion is given through the spur and bevil gearing, *b*, and *n*, to the horizontal shaft, *f*, and to the friction bowls, *g, g*, and through them by their frictional surfaces of contact to the friction discs, *d, d*, and thus to the warp, and the cloth beams respectively. Now the rate of speed at which these beams will be turned, the fabric taken up, and the warp let off, will be regulated by the relative positions of the friction bowls, *g, g*, against the surfaces of the friction discs, *d, d*, nearer to, or further from the centre of motion; and

these positions are regulated by the diameters of the beams themselves through the rollers, *i, i*, and the arms, *h, h*.

The next improvement described, consists in the application to looms, of loose or flying reeds, designed for the purpose of moving back, whenever the shuttle traps in the shed of the warp, and misses boxing. The reed, when beating up, [if the shuttle has duly completed its course,] is secured in a stationary manner to the slay board, by means of bolts, but which, if the shuttle traps, immediately become withdrawn, and set the reed at liberty, which, moving back as the slay beats up, is prevented from coming against the trapped shuttle and injuring the warp or the fabric. This improvement is illustrated in fig. 5, which represents an elevation of the apparatus, showing

Fig. 5.



the slay beam in section; *a*, the framing of the loom; *b*, the slay beam; *c*, the reed, which is hinged at its lower edge to the lever, *d*, moving upon a fulcrum, *e*, attached to the underside of the slay beam; *f, f*, are eye bolts, secured to the back of the slay beam, through which, and the eyes in the levers, *d*, passes the pin, *g*, attached to the end of the curved lever, *h*, the fulcrum upon which it moves being the ordinary stop-rod; the other end of this lever carries the vertical lever or piece, *i*, pointed to it; there is an inclined side on this piece, which acts upon the tail of the lever, *d*, and moves the reed back; upon the inside of the framing, *a*, of the loom is fixed an inclined plane, having a hole or opening upon its upper end. The action of this apparatus is as follows: The loom being in operation, and the shuttle duly passing through the shed, and boxing in a proper manner, when the slay

beats up, the bolt, *g*, will not be withdrawn, but if the shuttle gets trapped, the piece, *i*, will be prevented from passing into the hole upon the upper end of the incline, the bolt, *g*, will be withdrawn, and the reed, *c*, allowed to fall back by the movement of the levers, *d*, and thereby the slay may proceed to beat up without any probability of injury to either the warp or fabric.

The last improvement described under this head of the specification consists in the manner of making and constructing the forks of the weft detector apparatus, by casting them in brass or other cast metal, as malleable cast iron, and after casting and properly annealing, bending them to the curvature or shape required.

The fifth part of the specification relates to the formation and construction of patterns and models, and the manner of moulding such models or patterns, for the purposes of casting them in metal. This consists in dividing the pattern into two or more parts, and attaching such parts to the opposite sides of a flat plate, and moulding both sides at one time, by means of two flasks, or mould boxes, and when these are separated, and the pattern removed, the two flasks are brought together, and form the mould into which the metal is cast.

The next improvements in moulding for casting metals, consist in the employment of a flask, or mould box, composed of three or more parts, which are capable of being separated from each other, for the convenience of removing the parts of the pattern, and forming the interior of the cylindrical mould with green sand instead of dry sand cores.

The sixth part of the specification relates to the arrangement and construction of machines, employed for boring, turning and shaping metallic articles, or parts of machinery; and the first of the improvements described under this head, consists in the adaptation to the ordinary boring and turning lathe, employed for boring and turning metal cylinders and rollers, employed in the manufacture of fibrous materials, of two separate and distinct boring heads, or apparatus,—one placed at each end of the bed of the machine,—the roller or cylinder being secured to the bed in the usual manner, between the boring heads,—the boring bars or turning tools being driven in con-

junction, and they are also caused to approach each other, and meet at the middle of the roller or cylinder; by this means the roller, or cylinder, will be bored in one-half the time than by the usual method of performing those operations with one bored head or cutter only.

The next improvement under this head, consists in the employment of several drills, cutters, or boring tools, mounted upon as many separate spindles, or mandrils, in one headstock in the machine, and driven simultaneously, for the purpose of boring or cutting as many articles (as bobbins) as there are cutters, at one time; the articles being moved up to the cutters by hand simultaneously, by means of a suitable slide, to which they are attached. An adjustable stop is attached to the machine, for the purpose of regulating and determining the extent of the boring or cutting, and when that is effected, the revolutions of the spindle or mandrils are caused to be suspended. The rate of speed at which the articles to be cut, or bored, are moved up to the cutters, may also be regulated so as to increase or diminish it as desired.

Another improvement consists in giving motion to and working a rimer or broach by mechanical power. Upon one side of the headstock of the last described machine, and at right angles, is placed a smaller headstock; this carries a mandril, to the outer end of which the rimer is fixed, and worked by a pair of bevil wheels from the main mandril.

The next improvement consists in the manner of forming the bearings, mounting the spindles, mandrils, and other revolving axes in them; the bushes or collars are circular and conical, two being employed for each bearing, one within the other; by screwing the inner one further into the outer, as it wears, the true centre of the mandril or axis will always be preserved.

The next improvement consists in forming and making the blocks holding the cutting tools in turning, boring, and cutting machines of wrought instead of cast iron.

The last improvement consists in so arranging turning lathes, that two cylinders or rollers may be arranged and turned simultaneously by tools placed on opposite sides of the machine, the rollers

being arranged side by side, and not end to end, as has been sometimes before done.—*Patent Journal*.

PROSSER, IMPROVEMENTS IN SUPPLYING STEAM-BOILERS WITH WATER, AND IN CLEARING OUT THE TUBES OF STEAM-BOILERS.

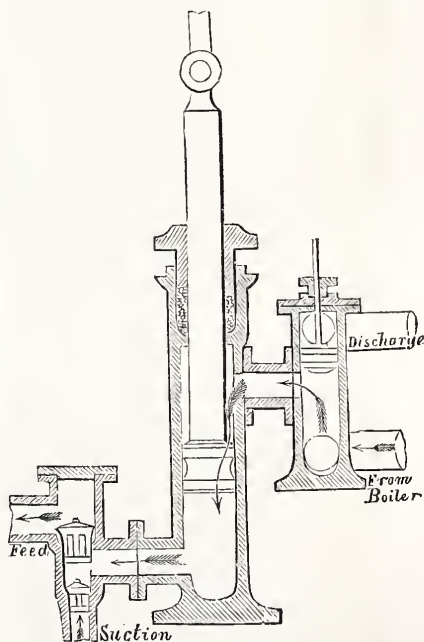
This method of supplying boilers with water, consists

First,—In an arrangement by which the feed pump, as well as feeding the boiler with water, is made to discharge water from the boiler in cases where the impure state of the water used for supply requires it to be done, for the purpose of preventing a deposit of the salts contained, and consequent incrustation and destruction of the boiler.

Secondly,—In apparatus applied to steam engines, by which the air is extracted from the feed water before it enters the boiler, and the material composing the boiler consequently saved from corrosion.

This arrangement of the feed-pump, for the purpose of enabling it to discharge water from the boiler as well as supply the feeds, is, of course, a combination or compound of the feed-pump, with the brine-pump at present used for discharging the brine from the boiler. It is effected by giving the feed-pump a double action, as shown in the accompanying engraving, by which it will be seen that the plunger of the feed-pump has a piston attached, which exactly fits the barrel of the pump. The valve by which a communication is effected between the barrel of the feed-pump may be of any kind most convenient. In the engraving it is a piston valve, moved by a rod passing through a stuffing-box and connected with the machinery of the engine. When the plunger of the feed-pump descends, as is shown in the engraving, the valve opens the communication with the boiler; the water from which, as the valve shuts the discharge off at the same time, and consequently cuts off all communication with the atmosphere, rushes forward to fill the vacuum created by the descent of the piston; and when the piston gets to the bottom of the barrel, the space be-

tween the plunger and the inner surface of the barrel will be quite full of water; the water so filling this space is forced upwards by the upward motion of the piston, and the valve having opened the discharged pipe, and shut the passage from the boiler, is discharged, either at once into the air, or into a case or vessel, through which the feed-pipe is made to wind, that the feed-water may gain as much heat as possible from the brine which has just left the boiler. The discharged water not being forced through a loaded valve, as in the case of the common brine-pump, requires much less power to discharge it. The patentee



states, that the pressure exerted upon that portion of the piston between the plunger and the barrel, upon which the water from the boiler presses, is sufficient to counterbalance the effort necessary to discharge the water; so that, by this arrangement, no more power is required to feed, and to discharge the brine from the boiler, than to work the feed-pump alone. The proportion of water discharged by this double action of the feed-pump, de-

pend, of course, on the size of the space between the plunger and the cylinder; this size should be regulated according to the state of the water used. The contents of the space will be found from the proportion of the water that ought to be discharged to the quantity supplied by the feed-pump. This may be conveniently determined as follows:—Let a portion of the water to be used be evaporated in a graduated glass vessel. Supposing now, for example, that when one quarter has been evaporated, the deposit commences to show itself on the glass, then the quantity that ought to be discharged from the boiler should be rather more than three-quarters of that supplied, as when one-quarter has been evaporated, the remaining three-quarters are found to be saturated with the saline matter contained. The feed-pump should therefore supply four times the quantity required for producing the necessary steam, of which the discharge of three parts is performed by the upward action of the piston and plunger. The means by which the tubes are prevented from corroding is, by heating the water before it enters the boiler, to such a degree as, when exposed to the action of the vacuum in the condenser, may cause the whole of the air contained to be extracted, thereby rendering the corrosion, which is the action of the oxygen of the air contained in the water upon the surface of the metal of the boiler, impossible, from the entire absence of oxygen. This is effected by causing the water to flow from the hot well into a small boiler or heater, placed in any convenient position in the furnace or flue; thence it rises, by the pressure of the atmosphere, into an air-tight case or chest, the top of which has a communication with the condenser, while to the bottom is connected the feed-pump, which, of course, may be of the description above mentioned. The water is prevented from rising to more than a convenient height in the case, by means of a valve, having a float attached, so that when the float rises to a certain height, the valve closes the communication with the heater. The water being heated in the heater is exposed in the case or chest to the action of the air-pump, by means of the before mentioned communication between the case and the condenser, so that the whole of the air is

extracted, and the water entering the feed-pump perfectly free from it. [This arrangement would, of course, keep the condenser at a lower vacuum than usual, and it would be a question how far the lowering of the vacuum, together with the cost and working the apparatus, would be compensated for by the beneficial effects of the extraction of the air from the water.]

The apparatus for cleansing the insides of boiler tubes, consists of a steam chest, applied to the end of the boiler, having opposite the end of each tube a short tube traversing its width, and fixed in the outer side; while on the inner side, next to the boiler, is a small annular space round the end of the short tube, through which the steam would rush, upon a communication being made, by means of a valve for that purpose, between the steam in the boiler and the steam chest. By a conical form given to the end of the small tube next the boiler the steam receives a spreading force of great power, in clearing away any substances, such as soot, &c., that may be on the inside of the boiler tubes. The steam chest should be divided into a certain number of compartments, so that a convenient number of the tubes may be subjected to the action of the apparatus. It is evident that a movable apparatus may be used instead of the steam chest, as above described, the axis of every aperture through which the steam rushes through the boiler tube, for the purpose of cleansing it, being the axis of the tube itself.—*Patent Journal.*

COCKER'S CIRCULAR FILE.

This so-called circular file, or cutter, is in reality a shaping machine on a small scale; the peculiarity being that, instead of a rose cutter, which can only be sharpened with a file, and must be softened for that purpose, a series of distinct cutters are fitted into a disc, whence they can be easily removed, and then sharpened on a grindstone. At a small additional expense, a slide rest could be added to it to carry the work. The disc is driven either by engine power, or by a treadle, where steam power is not at hand. Fig. 1 is a side

Fig. 1.

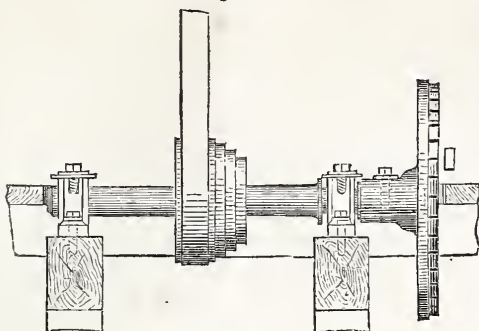


Fig. 2.

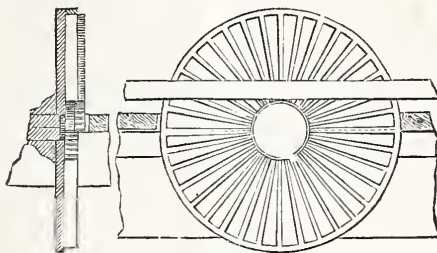
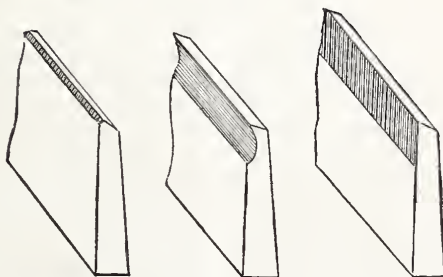


Fig. 3.



elevation, showing the disc without the cutters. Fig. 2 is a front view and section of the disc, the upper half showing the cutters, with the rings inside and outside, which hold them in position; and the lower half, the disc and grooves, without the cutters and rings. Fig. 3 are the various kinds of cutters used full size. The arrangement has been registered by the manufacturers, Messrs. Cocker & Son, of Sheffield, and we have no doubt, although we have had no personal experience of its working, that it will prove a useful as well as economical machine.—*Glasgow Practical Mechanic*

CAST-IRON GIRDERS.

For Appletons' *Mechanics' Magazine and Engineers' Journal*.

I am induced, by the perusal of the article in the June number of the Magazine, pages 330-335, to say a few words more on the subject of the cast-iron girder.

Whether Mr. Fairbairn's "opinion" contained an "acknowledgment of a mysterious or hidden agent" or not, cannot be very important; but having been rebuked for "seeming to suspect" such a thing, I will merely suggest whether the expression of an "opinion," as an opinion, does not always amount to an

acknowledgment that the subject is not fully comprehended; in other words, that there is something "mysterious" about it. Further, I would correct a trifling error of the defender of Mr. Fairbairn's "opinion." Instead of saying "his" (my) "argument *begins*," he should say, *concludes*, "with denying the existence of a mystery." These little errors are *sometimes* important.

In the paragraph preceding the one here referred to, the defender institutes a sort of comparison between the professional standing of Mr. Fairbairn and my humble self, and insinuates that neither I nor any one else need expect to overthrow Mr. Fairbairn's "opinion," "except by arguments based on an *experience* equally extensive with his." So mechanical and mathematical questions are to be decided by the "*opinions*" of those most experienced in the construction of mechanical works; and a dray horse or a jackass is better authority in questions on motive power than a Stevenson or a Pambour, because the former are more experienced in moving loads.

I have much respect for Mr. Fairbairn's abilities, and am grateful to him for his labors and researches, from which I have derived valuable information; but don't tell me I must not make a mathematical investigation of an interesting subject in mechanics because I may be led thereby to a conclusion differing somewhat from Mr. Fairbairn's expressed "opinion." That would be too tyrannical entirely.

The defender says, Mr. F. did not "acknowledge" any mystery. *He* does not acknowledge any mystery. "There is no mystery in shrinkage"—he understands it perfectly, and can "calculate it *accurately*." "It amounts to *about* one-eighth of an inch to a foot." (Is it exactly the same for all kinds of iron?) Very well; calculate it "*accurately*," and point out its effects *particularly* in weakening the girder in question—reduce it to mathematical calculation and demonstration, and your conclusions will stand on their own merits, without requiring the authority of professional standing and large experience to rely on.

"Shrinkage," says the writer, "is a contracting of the particles which have been expanded, thrust asunder by the action of heat."

The very language employed in this

explanation shows it to be all a profound mystery. Particles—what are particles? the word indicates simply *very little parts*,—but who knows how little, what shape, how far apart they are when cold, and how heat operates to "expand" or "thrust them asunder." The same gross terms are employed as would be used in speaking of a strong man making his way through a crowd of people, applying his elbow to one and his shoulder to another—pushing one this way and another that, "thrusting asunder the particles" till he effects a passage among them. And yet how different is this from the expansion of bodies by heat; still, the difference is so imperfectly understood that we can do no better than use the same terms to express these most dissimilar phenomena.

Are the "particles" themselves made larger by heat, or only "thrust" farther apart? I'll bet you don't know, notwithstanding you say "shrinkage is no mystery."

Page 333, the writer says, "Such a want of due preparation we find on the beam in question, as shown page 11, figs. 2 and 3. The centre with its great depth and heavy vertical ribs and shelves, and the glands at the ends, would both continue hot long after the light web between them had already cooled to its ultimate limit of contraction. Both these parts would therefore act on the part between them in the direction of extending its fibres, or tearing them asunder."

I must confess this is not very clear and satisfactory to me. Why will not the writer condescend to state, as he professes to understand it perfectly, exactly how much longer the heavier or thicker parts are in cooling than the thinner—how much the former contract after the latter have ceased to contract, and precisely what effects are produced thereby on the parts where rupture ensued?

As the case appears to me, the beam was very *well* proportioned for cooling without much strain. The vertical part in the centre is little or no thicker than other parts of the web,—the web at the bottom has the same thickness as the flange connected with it, and so at the top. The glands, as the writer calls them, at the ends have also about the same thickness of metal as the web and flanges. Where is this great disproportion? And in case the upright portions

at the middle and the ends, were to continue shrinking some time longer than the intermediate part, would it not rather produce *compression* upon the intermediate uprights, than *tension* or "tearing asunder?" When and how is this action of "tearing asunder" by the shrinking of the middle and end portions to be produced, and what does it amount to?—what portion of the strength of the material does it exhaust? It is not satisfactory to me to assert that the unequal shrinkage caused the failure, and the effect of shrinkage was the difference between the load that broke the beam, and the load that Mr. Fairbairn estimated the beam capable of bearing if cast without openings in the web.

I will here remark that I was fully aware of the shrinkage of iron in cooling, and that more or less strain is almost always produced on different parts of castings by unequal periods of cooling; and in saying that the breaking of the beam under consideration "was not occasioned by any defect in the strength and texture of the metal, occasioned by unequal shrinkage in cooling, or any thing else," I meant that that was not the principal, nor a very important item in the cause of failure, having, as I considered, demonstrated that there were mechanical forces acting at the broken points sufficient to produce the effect, upon the supposition that the metal was perfectly sound and of the ordinary strength. This being the case, as my calculations led me to conclude, if the shrinkage had materially injured the strength of the beam, it would have broken sooner than it did.

Now the writer states, "he (I) distinctly affirms that a defect in the texture of the metal from unequal shrinkage had nothing to do with weakening the beam or causing fracture." This, to my apprehension, very considerably misrepresents the legitimate purport of my language. I said what I have quoted and explained above, and nothing more on the subject.

I calculated the horizontal thrust of the arched portion of the beam to be 537,000 lbs. with 80 tons placed on the centre. My critic does not undertake to show this calculation to be erroneous. Nor does he attempt, by any direct, and (to me) intelligible reasoning, to show that this thrust does not produce the

tendency to break the several parts, the breakage of which I have attributed to it; nor that those parts could, if sound and good, offer more resistance to the thrust of the arch than I have allowed them. How then does he attempt to avoid the conclusion I arrive at?

I will take his own words, and see what can be made of them.

"He also calculates the power of resistance of 'each rafter,' and its abutment on the 'tie beam' at 603,000 lbs.," (marking by quotation points the terms "rafters" and "tie beam," though the expressions are not used by me in such connection.) "Now the two rafters would be 1,206,000 lbs., against the thrust of 537,000 lbs., or less than one half; an excess sufficient to insure safety."

I shall be obliged to repeat this in parts, to show its beauties and accuracies. "He calculates the power of resistance of each rafter," (I said nothing about "the power of resistance of each rafter," or any rafter,) "and its abutments on the 'tie beam' at 603,000 lbs."

I suppose the writer means to say so far, which is the fact, that I calculated the power of all the parts that could resist the thrust of the arch, to be capable of affording a resistance of 603,000 lbs. to said thrust, provided they were strained so as to arrive at the breaking point simultaneously, which is not strictly so, as I explained in my original article. He then adds a conclusion of his own, as follows:—"Now the two rafters would be 1,206,000 lbs. against a thrust of 537,000 lbs., or less than one-half."

How would the *two rafters* be 1,206,000 lbs? I suppose he means that the two rafters (the halves of the arch) would be resisted with a force of 1,206,000 lbs., as he says, against 537,000 lbs.; that is, he estimates the power of both abutments as acting against, and receiving the thrust of one end of the arch. The 537,000 lbs. was the calculated thrust of the arch at each end, and I am unacquainted with any method by which one end of an arch can receive the full support of both abutments.

He says further, that this is "an excess (1,206,000 against 537,000) sufficient to insure safety." If he thinks so, I don't want him to proportion cast-iron work for me. I would not trust an excess short of 100 per cent. greater.

Again, my critic says, "The rafters, however, did not take up all the thrust. Viewed as a truss, it consists of three elements; the rafters, the main beam, and the pillars, which take up considerable of the weight and strain on rafters, and transfer it on the straight beam." Meaning, I suppose, that the straight bottom part of the beam sustains a considerable part of the load, by virtue of its lateral or transverse stiffness, and thereby diminishes considerably the thrust which the load would otherwise produce on the arch.

As to that, before a beam can resist laterally, it must be deflected out of its natural line, to a greater or less extent; and before it can offer its extreme power of resistance, the deflection is considerable, depending, of course, on the length and diameter of the beam, as well as some other circumstances. Now, before the lower part of the beam could be sufficiently deflected to offer any considerable resistance laterally, the ends of the arch must be thrust out horizontally to some extent, as it is manifest they could not be, but to a very *limited* extent, until let free by the breakage of some of the parts where fracture took place. Moreover, the effect of shrinkage *had something* to do toward preventing the possibility of the lower part of the beam sustaining much by its stiffness. The top flange being only 2" thick, cooled quicker than the bottom, which was 3" thick; and the latter, by continuing to contract longer, of course sprung the bottom and top parts upward in the centre out of their natural line, which line they had a native tendency to gain, and must gain before they could support any thing by lateral stiffness. Can this be otherwise?

But the writer says, "if we calculate from known rules, the strength of this straight beam to resist a load transversely, and diffused throughout its length by the sturdy pillars 1—7, also the strength of rafters to resist horizontal thrust—we find that the beam was too strong, and would have safely carried 280 tons instead of 80 tons."

I am sorry we were not favored with the calculations and the "known rules," for I must confess the rules that would bring out such a result are *unknown* to me. In the first place I cannot regard

the weight as "diffused throughout the whole length of the beam by the pillars;" for this requires the supposition that the arch is absolutely inflexible, whereas it is much more flexible than the bottom part of the beam, being much lighter. Suppose a 4" plank laid horizontally with seven blocks distributed over its length, and a 2" plank laid upon the blocks, with a load on the centre of the 2" plank. Does any body suppose this two inch plank and the seven blocks can distribute the load equally over the length of the 4" plank? Or that the arch and the 7 pillars can distribute the load over the straight part of the beam in question? It appears obvious to me that it can only do it to a very limited extent in either case, and that if the straight part of the beam be estimated to support any thing by transverse stiffness, it must be considered as acting in the middle.

Now what would this straight part of the beam bear in the centre? If its cross section were a simple rectangle, 11" in depth, and 84 inches in area, it would bear about

$$24000\text{lbs.} \times \frac{11''}{20'} \times 84 = 92400\text{lbs.}$$

But I will suppose its peculiar form of section *might* increase its capacity to 120,000 lbs.

Again, what amount of horizontal thrust could the "rafters" resist; or, rather, what weight could they sustain? They could only sustain enough to overturn the abutments opposed to their horizontal thrust, which I showed in my former article to be only about the weight due to a thrust of 603,000 lbs., which is about 201,000 lbs., and this added to the 120,000, for the transverse strength of the straight part of the beam as above, makes 321,000 lbs., or 143 tons, at the extreme, instead of "280 tons with safety," as my critic gives it. Now I would not regard a beam as capable of bearing 280 tons, with safety, unless it possessed an absolute *calculated* strength of at least 1000 tons.

I therefore repeat, that I should like to see the calculations and "known rules," by which the beam can be shown to be capable of bearing 280 tons with *safety*, in virtue of the transverse stiffness of the "straight beam," and the sustaining power of the "rafters."

But the reasons above given, to me, are conclusive, that to allow *any* thing to be sustained by the transverse strength of the straight part of the beam, is entirely unwarrantable.

In fact, I feel warranted in the conclusion, that essentially, the whole load was sustained by the arch, and that it produced the amount of horizontal thrust that I attributed to it in each direction, and that the fractures were all caused *essentially* thereby, (except those of the top and bottom flanges near the middle of the beam,) before the lateral stiffness of the top and bottom portions of the beam were brought to sufficient tension to support any considerable part of the load; and the said top and bottom portions being thus set free of one another for nearly one-half their length, could only resist, by the individual stiffness of the two, the same as if they had been placed side by side.

The author, then, by a curious mode of reasoning, professes to have brought "to the ground" my second inference, to wit, that an arched *open* beam or truss should be so formed, that the axis (centre of resistance) of the arch meet the axis of the *chord*, or *part that is to sustain the thrust* of the arch, (which is the lower flange and the part of the vertical web connected therewith, notwithstanding the critic's denial,) directly over the centre of support.

He says "the best truss for a *wooden* beam is a triangle," &c.; that is, two braces meeting at the top, and connected at the feet by a chord or tie to sustain the thrust.

Now, if this is the best form for wood, why not the best for iron? and it is the very thing I recommended. But my critic says, this "has been found to be an insecure construction." But in spite of his learning, and Mr. Fairbairn's great experience, I am ready to maintain by theory and experiment that this is not so. "This," says the author, "would at once lead to the supposition, that a girder resists the strains differently from a truss."

If a girder is formed differently from a truss it may resist differently; if formed in the same way as a truss, why should it resist differently? Is there any better reason than because one is *called* a girder and the other a truss?

His remarks upon the merits and de-

merits of different kinds of arches are very interesting, and perhaps are worth repeating here.

"Of arches, the circular are the best, and the nearer a semi-circle the better; a half ellipsis is also used, because it transfers the strain (pressure?) *vertically* upon the abutments. But for the top flange of a girder, the parabolic curve, or the flat part of an ellipse, is the best," &c. Both these curves are the very worst for arches, i. e., when the arch has to carry the weight. (If the arch does *not* carry the weight, what is it good for?) Now for the conclusion: "To calculate the strength of the girder on the principles of an arch or truss, is *therefore* inadmissible," &c. *Wherefore* inadmissible? Is it because, as the author *says*, (without proof) "a triangular form of girder is an insecure construction for iron, though it is the best for wood?" or is it because a semicircle is the best form for an arch, and the parabolic curve, or the flat part of an ellipse, the best form for the top flange of a girder? Or because both these forms are the very worst for arches?"

I can find no better *wherefore* in the reasoning; and consequently I cannot see why the succeeding conclusion follows, to wit, that "Mr. Whipple's second inference, (page 221,) *therefore* falls to the ground."

But it is not enough that my "inference" is floored (brought "to the ground"), to *prove* that it is down, and must not attempt to rise again. He says Mr. Fairbairn has built two or three girders, of which he gives sketches, in which the arched top flange did not come down to meet the (supposed) "chord" over the points of support. These have so far "proved sufficient, and there seems" (seems to whom?) "to be no waste of metal."

It is a sufficient answer to this to say that these were *full webbed* girders, whereas my "inference" was *expressly* in reference to "*open*" arched girders.

I have followed the author as far as I deem it profitable. I have endeavored to give fair specimens of his correctness of statement, his clearness of illustration, and his logical closeness of reasoning. I will not extend this communication—already too long.

S. WHIPPLE.

PHILLIP'S FIRE ANNIHILATOR.

For Appletons' Mechanics' Magazine & Engineers' Journal.

No doubt, much has been said in favor of this new mode of extinguishing fires which will not be found true in ordinary practice; but does not the success of the trials made demonstrate, that there may be an improvement made on the mode now in ordinary use by diluting the carburetted hydrogen (which is the source of flame) with carbonic acid, or other unflammable gas? and are we not justified in asserting that Phillip's experiments prove that it is not so difficult to accomplish this as might be supposed, and that a comparatively small quantity of carbonic acid will render hydrogen unflammable? Now, it must be evident to every one, that if you stop the flame, a small quantity of water well applied will soon extinguish the burning embers of the large timbers. Now, let us look at what takes place in the ordinary mode of extinguishing fires;—the heat is rapidly decomposing the wood and other combustibles, giving off carburetted hydrogen, which becomes ignited, forming flame, and setting fire to every thing around; water being then poured on, steam is formed, which is decomposed by coming in contact with the red-hot carbon of the charred timbers; the oxygen of the steam unites with the carbon, thereby liberating the hydrogen to still further increase the already terrific flames; thus is explained the remark sometimes made at large fires, "when the engines began to play, the fire seemed to burn fiercer." If any of your readers doubt the fact of water producing flame under the circumstances mentioned, a very simple experiment will convince them of this truth. Let a very small quantity of boiling water be sprinkled on the burning coals, when at a clear white heat, in a stove, and it will flash as quick as though alcohol had been poured on. I think there can be no question but that the combination of the two modes, viz.: incombustible gas to prevent the flame, and water to cool the red-hot embers, is most desirable, and would greatly diminish the ravages of this furious destroyer. If water be not used to cool the embers, the flames would be rekindled in a moment, if the supply of incombustible gas should be stopped, and it would be no easy matter to produce for hours such a stream of it as would

be necessary in the case of a large house on fire; and besides, the addition of the water would render it superfluous. The only questions that remain to be solved are, what will be the best source from which to obtain the incombustible gas? and then, what will be the best mode to apply it? But these questions cannot be satisfactorily answered except by trials of the various plans by which these objects might be accomplished. In the mean time, no doubt, great good would be accomplished by a simple apparatus, strongly made, for evolving carbonic acid from chalk, by means of sulphuric acid, with pipes to convey it where needed.

C. D.

Newark, N. J.

MINOT-ROCK LIGHTHOUSE.

Editor Mecs' Mag.:

SIR,—Public attention having lately been called to the construction of the lighthouse lately washed off Minot-Rock, and the character and cost of the Eddystone Lighthouse, and others of its class, appearing to have been misunderstood, some of the data may be acceptable.

In but few works treating of the Eddystone structure are there any statements made as to the cost. The Ency. Edinensis, Nicholson's Diet., and Cresy's Ency., are silent on this head. Jamieson's Diet. (London, 1832) gives a comparative estimate of the proportions and cost of the Eddystone and Bell-Rock Lighthouses, as follows:

	Eddystone.	Bell-Rock.
Height of masonry above Rock,	70 feet.	100 feet
Drain of first entire course,	26 "	42 "
Cubic contents,	13,147 "	28,530 "
Expense, about	£21,000	£61,331 9s. 2d

The material of which the Eddystone is composed internally is an oolitic stone from the adjacent island of Portland, with an outside case of granite or gneiss from Cornwall; the Eddystone Rock itself is of this latter character, and at low water has an exposed surface of 65ft. by 35ft. It is 10 miles from Ram's Head, the nearest point of land, and about 14 miles from Plymouth.

The Bell-Rock Lighthouse was built of red sandstone, cased with Aberdeen granite, the Rock itself being a sandstone of the same character as the adjacent cliffs of Red Head, from which it is distant 16 miles. At the lowest ebb of

spring tides the rock rises about 4 feet out of water and has an exposed surface of 427 by 230 feet.

Placing some reliance upon the above data, the statement that the cost of such structures varies from \$250,000 to \$500,000 appears to me somewhat exaggerated, nor does the late accident tend to make the \$25,000 to \$50,000 screw pile lighthouse appear more desirable. The Eddystone was finished in 1759, and from that time to this, a period of 92 years, the structure has not required any repairs. Nicholson in his Dictionary says:

"It has now stood 55 years, and has withstood the most violent attacks without sustaining the slightest injury."

Smeaton's name may go down to future ages linked with that of Sostratus, whose square granite Pharos of Alexandria reared its head towards heaven for 16 centuries.

A contemporary paper takes it for granted that no lighthouse opposing a large surface to the water could possibly stand on Minot-Rock, owing to the violence of the waves. Nicholson, speaking of the situation of the Eddystone, says:

"The rocks are so peculiarly exposed to the swells of the ocean that the heavy seas broke over them with uncontrolled fury. Sometimes after a storm, when the sea is quite smooth, and its surface unruffled by the slightest breeze, the growing swell or under current meets the slope of the rocks, and the sea beats tremendously upon them, and even rises about the lighthouse, (92 ft.) overtopping it for the moment as with a canopy of frothy waves."

Another writer says of a previous building erected upon the same rock by Winstanley, finished in 1700 and washed away 1703:

"The sea from the prodigious height to which it rose at times, buried the lantern which was more than 60 feet high."

I can speak from my own experience of the long Atlantic swell and the short chopping seas of that coast, having passed the spot several times in bad weather, on one occasion being obliged to put into a neighboring harbor (Dartmouth) to refit.

A work published during the progress of the work upon Bell-Rock lighthouse,
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in speaking of the various plans proposed, uses the following remarks which will embody my ideas by applying them to Minot's Ledge:

"It is somewhat remarkable that any other plan for a lighthouse should have been for a moment contemplated than that of the Eddystone, which has so long resisted the tremendous fury of the billows rolling into the channel from the Atlantic ocean." K.

Cincinnati, June 13th.

Our correspondent is under a misapprehension in relation to the real base of the Eddystone Lighthouse. Although the first *entire* course of stone is given as 26 feet, this, it will be remembered, is at *high water*, and the curved profile of the lower part of the structure gives a spread at the foundation course of 40 feet, which, by reason of the dowelling and cramping of the stones to the rock, increases the virtual diameter of the foundation courses.

From the Chemical Gazette.

ON THE SPHEROIDAL STATE OF BODIES.

BY E. N. HORSFORD,

Rumford Prof. in Harvard University, Cambridge.

From the early observations of Leidenfrost, and the later extended researches of Boutigny, upon the so-called spheroidal state of bodies, much attention has been directed to the interesting phenomena considered under this name, and to the speculation, that a new law, superseding the ordinary laws of heat, was here illustrated.

It will be the object of this communication to show that these phenomena are not rare, and that they require no new law for their explanation.

In the experiment of dropping water upon a hot polished metallic surface, as into a hot platinum crucible, we have three bodies concerned in the phenomenon that follows, viz., the supporting surface, the water, and the layer of vapor interposed between them. The water rests upon a cushion of steam, continuously evolved by heat from the water, and assumes rounded margins as a result of the gravity of its particles toward its own

centre. Its condition approximates to that of a liquid entirely surrounded by a uniformly-elastic medium, as, for example, a drop of molten lead in air, and permits a proportionate approximation to the spherical form.

It is essential only that there be two bodies, one of them being fluid, between which affinity is wanting.

Corresponding with water in the ordinary experiment, called by the name of Leidenfrost, ether, alcohol, turpentine, a great variety of essential oils, and many other liquid bodies, may be employed. The conditions are the same. The liquid evolves a vapor, which, constantly issuing, prevents contact with the supporting surface. Here are three bodies and a high temperature.

Ether and oil dropped on water assume the spheroidal state. They have no affinity for the water. Here but two bodies and no heat are required. Quick-silver poured upon glass assumes the spheroidal state. It has no affinity for the glass. Here but two bodies are concerned. Water dropped upon glass strewn with charcoal dust or fine powder, like pollen, takes on the spheroidal state. Potassium and sodium thrown upon water assume this state. In the decomposition of the water producing potash, hydrogen is evolved; and with the heat arising from this union, and that of the potash with water forming hydrate of potash, water is vaporized, which with the hydrogen keeps the floating sphere and water apart. The dew-drop presents a spheroidal but little differing from the true spheroidal state. It rests in most cases upon the hairs or down with which leaves are covered, and is not in contact with the leaves or twigs.

The bead, as it is called, which appears at the surface of some liquids when violently shaken, and of which we have a familiar example on the water around the prow of an advancing sail-boat, is an instance of the spheroidal state of great interest. What prevents the prompt reunion of the bead with the mass is not so obvious.

There is a fact in the history of the barometer which merits attention, and which may have influence in explaining this phenomenon. When pure mercury has been introduced into a barometric tube, and thereafter boiled, so as to expel

all the air, upon erecting the tube in the cistern, the top of the column presents a certain curve, the meniscus, the character of which is dependent on the composition of the glass and diameter of the tube. If now a bubble of air be introduced, and then removed by carefully causing the mercury to sweep up and down the length of the tube, upon erecting the barometer the mercury will stand at the same elevation as before, but the meniscus will be less convex. Here, as in the case of the bead, it may be conceived that the mercury and water have condensed an infinitely thin layer of air upon their surfaces, which provide for the phenomena of the spheroidal state in the latter instance, and which modify the affinity of the mercury for the glass in the former.*

Of this class of facts, to none has more interest attached than to the recent experiments of Boutigny with molten metals. To him are we indebted for the first scientific consideration of this subject, although it appears that jugglers performed the feat of washing the hands in molten lead many years ago. Eleven years ago the author witnessed an explosion from the contact of molten slag with water, which expended most of its force upon the face and breast of a workman near. The shock prostrated and bruised, but did not burn him.

One form of the experiment is given in the adjustment of the wick of a burning spirit lamp with the fingers, which is every day practised by chemists.

In the experiment of passing the hand into molten iron, which has been repeatedly performed by the author without discomfort, it is necessary only, as has been noticed by Boutigny and others, that the surface of the skin be wet, or covered with some body like powdered resin, which upon the application of heat will readily vaporize. That the experiment may be safely performed, any one may satisfy himself by passing through the molten mass any highly-combustible substance previously moistened, as for example a stick of sealing-wax. When the hand, previously moistened, is passed into the liquid metal, the water is vapor-

* The condensation of gases upon the surfaces of solids is a familiar fact, of which the ignition of a jet of hydrogen by platinum-sponge is a well-known illustration.

ized, interposing between the metal and the skin a sheath of vapor. In its conversion into vapor, the water absorbs heat, and this still further protects the skin. It was thus in the case of the workman alluded to above. His face was streaming with perspiration, and the molten slag came in contact, not with the skin, but with the layer of vapor which rose upon its surface as the heated mass came near.

The explanation of Berzelius, offered some years since, and confirmed by all the experiments, so far as I know, that have been performed, is the following:—

In the Leidenfrost experiment, a layer of vapor continuously evolved from the inferior surface of the liquid, provides an aëriform medium which does not conduct heat, but merely transmits radiant heat, which, passing through the liquid, as through most transparent substances, heats it but slightly. Thus evaporation is slow. The temperature of the liquid, it is well known, remains constantly below that of the boiling point. This accounts for the much greater length of time required for water to evaporate when resting upon an oiled surface than when in contact with wood or metal; and for the length of time that dew-drops or spiders' webs will sustain exposure to the sun, when compared with that which would be required to evaporate an equal quantity of water from a surface where there is actual contact over a considerable area, and where conduction may take place.

The explosions sometimes following the first contact of a piece of potassium or sodium with water are due to the admixture of evolved hydrogen and atmospheric air. The explosion at the conclusion of the burning of the potassium or sodium is of another character. It is due to the sudden contact of the hydrate of potash when the temperature has become sufficiently low to permit it, and is analogous to the phenomenon witnessed when the surface supporting a mass of water in the spheroidal state is permitted to cool down until contact takes place.

The explosions occasionally witnessed where a large quantity of fused saltpetre has come in contact with water, are of this description.

The explosions of steam-boilers have recently, in several instances, been ascribed

ed to the properties of steam evolved from water in the spheroidal state, or evolved at the instant contact between the water and boiler is resumed. This is called a highly explosive steam. Not an experiment has been made, of which the author is aware, going to show any difference between this and ordinary steam. It is conceived, that, in some way, the mass of water in a boiler becomes separated from the interior surface of the metal, as in the experiment of Leidenfrost; and that upon cooling down to about 280° to 300° F. contact is resumed, and from the sudden evolution of steam, explosion results. But boilers of ordinary strength would sustain any pressure which could be exerted from steam, produced within its own walls at a temperature of 300° F.; and by the conditions supposed, the water in the boiler has been already more highly heated; else it could not have been *cooled down* to this temperature. A higher heat must have subjected the boiler to greater pressure, and yet that increased pressure had been sustained.

For Appleton's *Mechanics' Magazine and Engineers' Journal*.

MISCELLANEOUS REMARKS ON IRON AND WOODEN STEAMSHIPS.

In the June number of the "*Mechanics' Magazine and Engineers' Journal*," I perceive the specification of Jordan's patent system of ship-building. The date of this patent is not given, but I presume it is of recent issue.

The main feature of this invention is the combination of wrought iron ribs with a wood planking, to be sheathed with copper in the ordinary manner of wooden vessels. In addition to this feature there are also claimed ten other points, which being mostly mere modes of workmanship, for which ordinary ingenuity can easily find equally good substitutes, need not here be particularized. My object is principally to call attention to the fact, that this mode of construction for vessels is not original with Mr. Jordan, but had been actually practised in this country previous to the date of his patent.

In July, 1850, my attention was called to the following paragraph in the "*Philadelphia Ledger*" newspaper:

"A NOVELTY.—Four of the iron steamboats employed on the transportation line between this city and New-York, are being converted into wooden vessels, by planking being attached to the iron of the hull by means of screw bolts. Though protected by paint, the iron was found to have worn so thin by corrosion as to render them unsafe, but by this plan, adopted by Captain Loper, they are converted into substantial boats, and will, doubtless, be serviceable for many years to come. Two of them, the "Vulcan" and the "Anthracite," have been hauled out at Wilmington, one by Mr. Thatcher, and the other by Mr. Wood. The "Black Diamond" is rebuilding by Messrs. Simpson & Neil. Most of the upper planking has been completed, and she will be hauled out on the railway to-day, for the purpose of commencing the other portions of her hull. The "Ironsides" has been hauled out at Mr. Vandusen's yard, Kensington, and the work is well advanced. The state of these vessels, though only in use about five years, shows conclusively that there is no economy in constructing the hulls of vessels entirely of iron. Scales half the original thickness of the iron are taken from the interior of the hull, showing the progress of corrosion from the action of the water."

Being struck with the facts recorded in the above quotation, and feeling desirous of knowing the exact state of the case, I suggested to the Hon. D. L. Yulee, Chairman of the United States Senate Committee on Naval Affairs, well known for his lively interest in all matters pertaining to improvements in ship construction, &c., that he should address a letter of inquiry to Captain Loper, as such a letter from him would probably meet with more attention than from a person of humbler station. He accordingly sent the following:

"WASHINGTON, March 7, 1850.

"SIR :—I perceive from a paragraph in the "Philadelphia Ledger," that the iron hulls of the several steamers employed in the transportation trade between this city and New-York, had become so thin as to be unsafe; and that you had adopted the plan of covering them with planking.

"As the Senate Naval Committee are anxious to obtain information on the re-

lative advantages of iron and wood for naval steamers, I respectfully ask your answers to the following questions:—

"1st. What were the sizes, numbers, and propelling instruments of these vessels?

"2d. What usually constituted their freights, and for what length of time did their freights remain in them?

"3d. Of what thickness and quality of iron were the hulls originally constructed?

"4. What was the thickness of the iron when the planking was commenced?

"5th. How long have those vessels been built?

"6th. For what length of time did they usually remain at the wharves? and of what materials were the wharves constructed?

"7th. What was the state of the vessels' bottoms?—Foul or clean?

"8th. Does the deterioration of the iron take place externally or internally? and what is its character?

"9th. Have you any experience as to the effect of covering iron hulls with wood planking on the iron? and if so, what is its result?

"10th. How were the iron hulls originally protected?

"11th. In what portion of the hull was the deterioration most conspicuous?

"I shall be pleased to receive any specimens of the injured iron that may be convenient for you to send.

"Very truly and respectfully,

"Your obedient servant,

"(Signed,)

D. L. YULEE.

"R. F. LOPER, Esq."

In due course of time, Captain Loper replied with the following letter:—

"PHILADELPHIA, March 29, 1850.

"SIR :—I should have, some time since, sent you the information desired in your favor of 7th instant, but that I have been delayed in receipt of some portions of the required data from New-York, where the boats referred to were built. I take pleasure in submitting the following:—

"Answer to question 1st. These boats were propelled by one high pressure (non-condensing) engine, (cylinder) 18 inches diameter, and 24 inches stroke (of piston), driving two (stern-submerged) propellers, 5 feet ten inches diameter.

"Answer to question 2d. Their freights

consisted of merchandise of every description, they being part of a line of boats doing most of the freighting business between Philadelphia and New-York. Their cargoes generally remained in them from 24 to 48 hours.

"Answer to question 3d. The iron used for their sheathing, or shell, was one-fourth inch thick, and principally American. There was some English iron used on the bottoms of two of those boats; names not remembered by the builders, Messrs. Hogg and Delamater, New-York. The ribs were principally of T rail, and very heavy.

"Answer to question 4th. The thickness of the iron when the planking was commenced was very variable; in some places almost the original thickness, and in others like letter-paper. These differences were not confined to any particular part of the boats, but existed in different parts; and this caused much surprise to all who witnessed the fact.

"Answer to question 5th. These boats were built in the year 1842, and were only in operation during the period the canals remained open, about 8 months in each year.

"Answer to question 6th. These boats generally remained at the wharves from two to three days. The wharves were composed of hemlock timber.

"Answer to question 7th. The bottoms of the boats were clean.

"Answer to question 8th. The deterioration of the iron takes place both externally and internally. The oxidation externally, being constantly removed by the friction of the vessel in passing through the water, is not so perceptible, however, as that internally. I should say that paint of any description was unfit to coat iron where it remains under water, as the water in all cases soaks through the paint, and causes a most rapid oxidation. *From a close scrutiny of these boats, I have formed the opinion that iron can be protected only by the application of oil. I judge from the fact, that the only parts of the interior of these vessels which were good was directly under the machinery, where the oil used on the engine kept dripping, and the water in the vessel washed it over the bottom in that place.*

"Answer to question 9th. I have had no experience as to covering iron hulls with wood planking.

"Answer to question 10th. The iron hulls were originally protected by several coats of red paint, (red lead and oil,) and have been frequently painted since they were built.

"Answer to question 11th. The deterioration was most conspicuous on the sides and bottom, commencing between the loaded line on the inside.

"The plates of rust, which you will find inclosed in a box sent by express this day, will show the character of the oxidation. You will perceive, by examining the specimen done up separately in paper and marked A, how severe or rapid the oxidation is under a heavy coat of paint when it is under water. You will please, especially observe that this is on the inside of the boat.

"I am now building a boat for the freighting business on the plan of the model I left with you some years since; viz.: iron frame or ribs, and wood planking.

"I remain, sir, with much respect and esteem, your obedient servant and friend,

"R. F. LOFER.

"Hon. D. L. YULEE, U. S. Senate, Chairman Naval Committee."

From the above letter it will be perceived that the shells of these iron vessels were wholly corroded out in about eight years, their service being performed partly in salt but mostly in fresh water. Their destruction seems owing wholly to oxidation, the specimens of plate sent being totally converted into the peroxide and deutoxide of iron, no trace of the original metal remaining.

There is nothing remarkable in the better preservation of those parts of the shell immediately around the engine. Wherever there is a larger mass of iron collected, the oxidation is proportionably slower. Beside the principal portion of the engines was cast iron, softer or less dense than the rolled plate iron composing the shell, which was consequently electro-negative to the cast iron, and had its preservation at the expense of the latter. The presence of oil might have been advantageous in preserving the interior of the shell in the following manner: it is a solvent of the oxide of iron or rust, and would therefore remove it as fast as formed; and as a piece of iron which has acquired red rust in several places has its tendency to rust all over

greatly increased, the advantage of removing the rust as fast as formed in certain places, in order to prevent this *tendency* to rust, is obvious.

The wharves of hemlock timber, alongside of which these vessels were continually lading and unlading, had probably an injurious effect from the action of the acids contained in the wood. Oak timber is especially objectionable on this account, and in fact no timber should be brought into contact with iron; some separating substance should be always interposed.

Although the common products of the rusting of iron in fresh water and air, are hydrated carbonates and various mixtures of the protoxide and peroxide, likewise hydrated; yet in sea water, in addition to these, there are also certain basic chlorides, oxychlorides and sulphates formed and deposited on the surface of the iron. The free muriatic acid in the sea air also acts powerfully on iron.

With so extensive an interest open for protection there has, of course, been no lack of various schemes and plans for the preservation of iron. They have all, however, failed when applied on a large scale under the ordinary requirements of practice, however efficient they might be in theory, and on the small scale of the laboratory.

These various methods, which have been brought forward from time to time, may all be divided into two classes.

1st. Those which protect iron *mechanically* by covering it with a coating, not acted on by, and impervious to the deteriorating principle.

2d. Those which protect iron *chemically* by producing a change in its electric or electro-polar condition, with respect to the corroding agents.

To the first class belong the whole tribe of paints, varnishes and sheathings, with other metals electro-negative to iron, that is less corrodible alone. These act simply mechanically, or rather they do not act at all.

The second class was first pointed out by Sir Humphrey Davy, and is based on the law of chemical affinity; that is, that of two bodies, one having a greater and the other a less affinity for a third body, that having the less affinity will not combine with the third body, till the third body be saturated with that having the

greater affinity for it. By this process the body having the lesser affinity is preserved at the expense of the one having the greater affinity; chemical action still going on, but transferred from the body to be protected to the other which corrodes in its place.

Any metal electro-positive to iron will answer for such a protector, but zinc is the only one known, that can be practically used in the electro-chemical preservation of iron. It can be applied, spread over the whole surface, or in masses at particular points of action. In the latter mode of use it generally fails of its purpose after a few weeks from the following cause. It has already been remarked that the presence of a few spots of red rust on iron greatly increases its tendency to rust all over; now if the masses of zinc be applied in spots only, the intermediate parts of the iron may become rusted, and the increased tendency of the iron to rust, or, in other words, its increased affinity for oxygen may become sufficiently great to overcome the slight degree of electro-positiveness of the zinc, in which case corrosion of the iron goes on nearly as rapidly as before.

If, on the other hand, the zinc be spread evenly over the surface of the iron, the former metal, both in fresh and sea water, and especially the latter, becomes soon covered with a hard crystalline coat of hydrated oxide of zinc and of carbonate of lime, which preventing its further corrosion, the destruction of the iron goes on nearly as before.

In the use of zinc, for every 28 parts by weight that the iron *would have lost* by oxidation, 32·3 parts by weight of zinc are actually oxidated. It is wholly by virtue of this more rapid oxidation of the zinc that the iron is preserved.

All the patent paints which have been devised from time to time for the chemical preservation of iron, are manufactured with zinc as the base instead of lead. Heretofore none have been attended with success from the reasons before stated.

The great aim of modern steam navigation is to obtain the highest possible rate of speed. An increase of speed can be had in two ways, viz.: either by increasing the power or decreasing the resistance. The latter, in many cases, may be the preferable method. This decrease of resistance is had by sharpening the

ends of the vessel, but practical considerations soon impose a limit. Beyond a certain degree of sharpness the ends of the vessel cannot be carried, and retain sufficient strength. The reason of this is obvious from the following considerations. Suppose the hull of a vessel to be divided lengthwise into any given number of equal parts, each part would have a different line of floatation, but when joined together in one mass they have the same line of floatation, consequently those parts that would have sunk deepest when separated will now be held up or supported by the others, &c. The central portion of the hull, having the greatest displacement, therefore holds up the ends, or the ends are suspended from it by the stiffness of the material composing the sides. It is obvious that a limit would soon be reached, when the weight of the ends would overcome the stiffness of the sides and sink them down, *hogging* the vessel. In very sharp river steamers the ends, instead of being suspended at arm's length as it were from the centre by the stiffness of the sides, are suspended by tension rods, diverging from the top of posts placed on the keelson, in the central portion of the hull. In these vessels the great proportion of length to depth renders it impossible to sustain the ends by the stiffness of the sides. On the contrary, in the large ocean steamships of great depth proportionally to their lengths, recourse is had to a system of diagonal iron ties or straps, running obliquely from the centre to the ends of the vessel. These are sometimes crossed in the opposite direction, making a complete iron basket, enclosing the wooden hull, as in Collins' vessels, and some others. The United States steamship "Mississippi" had them in but one direction, acting as suspenders only; nor does it appear that there is sufficient gain by crossing them in the opposite direction by others acting as struts or braces, to compensate either their cost or weight, especially in an ocean steamship, where every pound of displacement can be profitably used for freight, or for fuel to give increased speed.

The use of iron ribs instead of wooden ones, when combined with iron keel, stem, stern-post, &c., making a complete rigid, iron frame, with braces and ties introduced between, must allow the con-

struction of sharper ends than where wood is used in the same positions; there will further result greater lightness of hull, and increased capacity within the same moulded dimensions, by the omission of part of the thickness of the wooden ribs and wooden ceiling, while the retention of the external planking obviates the principal objection to the use of iron hulls in sea water, viz., their rapid fouling. The many advantages promised by this new kind of ship construction, and the daily diminution in the price of iron, together with the as constant rise in the price of ship timber, will doubtless bring this new system into use; and if properly practised, the steamers built upon it will have higher speeds with equal powers, from the greater sharpness, and consequent less resistance, of their hulls.

I will conclude with a few remarks on iron vessels of the usual construction.

The construction of sea-going iron vessels dates back to 1820, in which year the "Aaron Manby" was built by Horsley & Co., for the navigation of the Seine. She made her first passage direct from London to Paris without breaking bulk. It will thus be seen that thirty years have elapsed since their first introduction, during which time a vast number have been constructed, and their merits, comparatively with wooden ones, ascertained.

With regard to first cost, there is, probably, but little difference, at the present prices, between wood and iron; if there be any difference, it is in favor of the iron. The total cost of the "Great Britain" steamer, a vessel displacing 3,000 tons, was, including machinery, only \$470,000. Repairs are also much less on iron than on wooden vessels, and the duration of the iron vessel is likewise considerably greater than the wooden one, as a general result, though there have been many cases of rapid deterioration—not more rapid, however, than have occurred in wooden vessels under peculiar circumstances.

As there is but little difference in the strength of iron, whether the strain be applied with or across the grain, it is peculiarly adapted to ship-building. The ease with which it can be wrought into the irregularly curved surfaces of a ship's hull without losing any of its strength, the solidity and durability of its rivet

fastenings, which enables the vessel to be formed, as it were, of one piece, are great recommendations. A wooden vessel is constructed of a vast many pieces of timber, of various forms and sizes, placed in peculiar juxtaposition, and depending on that placing, and upon each other throughout for support. If one become loose, the stability of all is endangered. This is evident from the well known fact, that if the calking of the outer plank be removed, the stiffness of the whole vessel is lost. The mode of fastening the wooden vessel is by an elaborate system of knees, treenails, iron and copper bolts, with nuts, straps, &c., &c.; and in large vessels, even all these are insufficient, and internal diagonal planking is now generally used. In the large steamers of Collins' line, just completed at New-York, the wooden hulls are completely enveloped in a wrought-iron basket, formed by straps of heavy iron, crossing each other diagonally, and firmly riveted together, preventing the dislocation of the wood. Fastening with copper or iron bolts is only secure for a time; but there is no accordance between the materials of wood and metal. The wood being the softer, the constant strain draws the nuts or heads into the wood, and the working of the vessel continues with increased effect as the fastenings grow looser.

The superior strength of an iron vessel is so well established, as to need no illustrations for its proof. These are the only vessels that will bear straining and "thumping," without going to pieces.

Iron vessels of the same external dimensions as wooden ones have a greatly increased capacity for stowage. In a medium sized vessel—say of 500 tons burthen, the difference would be about 18 inches in width and 12 in depth, making the capacity proportions as 6 for the iron and 5 for the wooden vessel.

The average durability of wooden vessels may be taken at about 15 years. Grantham, in his work on iron vessels, says, the Garryowen had been (then 1842) used 8 years in salt water, and was not perceptibly injured. The Clyde steamer *Fairy Queen* was 12 years old when broken up, and the original plates of her hull were found to be tough and strong, and to have lost but little by corrosion. The "*Cleveland*," Mersey

steamer, after a use of five years, had no perceptible decay below the water line. Above the water line a very slight oxidation commenced, and increased as the deck was approached. This was supposed to be caused by the leakage from the deck, the iron being unprotected by any coating. The "*Michigan*," "*Legare*," "*Water Witch*," and others belonging to the United States Government, have been in water for about 8 years without perceptible deterioration.

Iron vessels are not liable to injuries from fire or lightning. In tropical countries they are cooler, and free from vermin. They are not liable to leakage, and have no bilge water.

Iron is also specially adapted as a material for steamers with submerged propellers, from the facility with which the openings for the shafts beneath the water can be made. These openings in wooden vessels of large size are grave difficulties. In iron vessels, they merely involve the *bending* of the plate, there is no weakening by *cutting it away*. Moreover, if the vessel be of iron, the submerged propeller can also be constructed of wrought iron, instead of cast bronze, as it must be if the vessel be of wood and coppered, from the strong galvanic action of the two metals in sea water, which rapidly destroys the iron. The advantages of wrought iron propellers are their superior strength and lightness, and if it be a screw, in the greater thinness of the blade in the helical path, giving, of course, less direct resistance.

An iron vessel, carrying the same load, will have a considerably less draught of water than a wooden vessel, resulting from the less weight of hull, and the less thickness of bottom: this difference will amount to about 2 feet in a vessel of 500 tons burthen.

Nearly all of the above advantages in favor of iron vessels could be predicated in advance of experiments. They were very great, so great as to cause the construction of a large number of steamers of that material almost as soon as its general use was proposed. Many vessels of war were so constructed for the British and French governments, and even our own limited steam navy numbered the "*Michigan*," "*Water Witch*," and "*Allegany*." All the revenue steam-cutters were likewise of iron.

But it required time to develop the disadvantages of this material, which are now so well known and so formidable as to probably prevent hereafter the construction of any for sea-going purposes, though it can still be judiciously used for fresh water rivers and lakes. These disadvantages are, the "*deviation of the compass*," "*corrosion of the iron*," and "*fouling of the bottom*;" of these the last is the most important, and sufficient of itself to utterly condemn iron as a material for sea-going vessels. The loss of speed by a slight fouling of a vessel's bottom is very great; what then must it be when that bottom is covered with masses of large shells. This defect was early noticed in the "John Garrow," an iron sailing vessel, that made her first voyage to Bombay, in 1840. On her return, her bottom was found covered with a dense mass of shells.

The Treasury Department constructed a large number of iron steam cutters, some of which were used upon the lakes, and some upon the sea board. After a two years' service, Captain Fraser reported that the bottom of the "Jefferson," employed on Lake Ontario, (fresh water,) bore no appearance of fouling or corrosion. But with regard to those employed on the ocean, the accumulation of shells and barnacles in three or four months was so great as to materially lessen the vessel's speed. The "Legare," after a few months' service on the coast of Florida, returned to Philadelphia for repairs, and her bottom was found to be covered with long grass, large shells, and barnacles, to the thickness in many places, of several inches. The Mexican steamers, "Guadaloupe" and "Montezuma" were found thickly covered with large shells, when repaired at New-York, for a thickness of from three to four inches; and the navy steamer "WaterWitch," after six months' cruise in the Gulf of Mexico, was found completely covered with masses of oysters of medium size, and very palatable food. When employed in the North Atlantic and other seas of high latitudes, the fouling does not go on so rapidly as in tropical waters.

There has hitherto been found no kind of paint or external application that will save the iron from the adhesion of weeds and shells. Upon breaking off large clusters of the latter, the paint is

found perfectly fresh beneath. In fresh water, this objection of fouling, of course, does not apply; but for sea-going vessels it is sufficient of itself to utterly condemn the use of iron.

Another great objection to iron vessels for sea voyages, is the great variation of the needle, amounting sometimes to from 20 to 40 degrees. In some vessels, when heading nearly due north or south, the variation was but trifling, but increased with astonishing rapidity as that direction was departed from. It is said, indeed, that the loss of the "Great Britain" was owing to the variation of the compass, thus locally caused; and that Captain Hosken preferred enduring censure to injuring the interests of his employers by exposing the truth, as it would have ruined the vessel ever afterward for trade or sale. Be that as it may, those great variations of the compass, changing for every change of the vessel's course, must greatly increase the inconveniences and perils of navigating in iron ships.

OBSERVATIONS UPON PROF. WALTER R. JOHNSON'S EXPERIMENTS ON COALS.

For Appletons' Mechanics' Magazine and Engineers' Journal.
Continuation of article on Combustion of Coal by
B. F. Isherwood, in July number of Magazine.

These experiments upon coals were made at the Washington Navy Yard during the years 1842 and 1843, by order of the United States government. They were conducted in the usual high pressure cylindrical boiler with double return flues, upon a scale sufficiently large to insure such results as would ordinarily occur in practice; there being on an average 978 pounds of coal consumed at each trial.

From the large mass of data constituting the "Report," I have eliminated such results as appear to be of service in proportioning boilers, and in ascertaining the relative and absolute values of the different fuels for marine steamers.

The value of any particular variety of fuel for this purpose, will depend principally upon the evaporation power of its unit, and the number of units that can be stowed in a given space. But this will be materially modified by the grate surface required to furnish (with equal velocity of draught) the necessary amount of air for combustion; for, in marine steamers,

the grate surface is limited by the beam of the vessel—the maximum strength of the furnace being fixed by practice at 7 feet, beyond which it cannot be extended beneficially on account of the difficulty in firing. Again, the relative amount of clinker and soot are important to be considered, as the one, by covering the grates, prevents the access of air and retards combustion; while the other, by covering the flues, acts as a non-conductor and prevents the absorption of heat. Lastly, the per centage of sulphur is of some importance as its presence is decidedly injurious to the iron of the boiler; and in a minor degree the per centage of ashes should be considered, as they involve the labor of hoisting them overboard, beside occupying room in the furnace. A comparison of these properties will be found in the last table.

From the "Summary of Results" it appears, that of the dry gases (products of combustion) in the flue, 10 per cent. of bulk consisted of uncombined oxygen. As the proportion of oxygen by bulk in atmospheric air is one-fifth, there results that 50 per cent. of the gases in the flue was unchanged atmospheric air, and as carbonic oxide is nowhere observed, this whole quantity of atmospheric air is in excess over what was required for combustion at the experimental temperature.

The temperature of the gases upon entering the smoke chimney—that is, upon leaving the boiler—averaged 294° F., which, upon estimating the temperature of the furnace at 1000° F., gives a reduction of two-thirds of the heat. This indicates that a corresponding reduction of area of flue should be made; otherwise the gases with the reduced temperature would have a correspondingly reduced bulk, and if continued in a flue of the same area, would have a less velocity, and be accompanied by a greater deposition of soot. The gases had a velocity of exit into the chimney of $11\frac{1}{2}$ feet per second, there being on an average 8 pounds of coal consumed per hour on each square foot of grate. The area of flue at the bridge was $23\frac{1}{2}$ square inches to each square foot of grate. The smoke chimney was 58 feet high, with an area of $22\frac{1}{2}$ square inches to each square foot of grate.

The proportion of grate to heating surface was 1 to 26, and each square

foot of grate surface contained 50 square inches of air surface. The grate bars were $\frac{3}{4}$ inch thick, with $\frac{1}{2}$ inch spaces between them.

The average evaporation by each pound of coal per hour was 223 cubic inches of water by the anthracites, and 206 cubic inches of water by the bituminous, from the initial temperature of 63° , the air entering below the ash pit being 70° F. From each square foot of heating surface there was evaporated by the anthracites 55 cubic inches of water, and by the bituminous 61 inches of water; the escaping gases being at the respective temperatures of 273° and 302° , or the ratio of 1 to 1.106. The ratio of 55 to 61 is 1 to 1.109, or very nearly corresponding.

The per centage of total waste from the anthracites compared to that from the bituminous was as 1 to 1.07. The comparative per centage of clinker alone was as 1 to 2—of soot alone as 1 to 5.70.

The bulk of air at standard pressure of 30 inches barom., and temperature of 60° F., required for the combustion of the anthracites, was, as compared with that required for the bituminous as 1 to 0.724.

The spec. grav. of the anthracites was 1.50; of the bituminous, 1.33.

The space required to stow one ton of the anthracites was 42.14 cubic feet; of the bituminous, 45.57 cubic feet, or the ratio of 1 to 1.06. The per centage of evaporative power expended in expelling the products of combustion, was, for the anthracites, 14.58; for the bituminous, 16.34, or in the ratio to each other of 1 to 1.121.

In the single experiment on dry pine wood, its evaporative power for the unit of weight was one-half that of coal, and the same grate surface and draught consumed twice the quantity by weight per square foot of grate, showing that the same proportions of boiler would give the same result—of course, requiring twice the weight of fuel. Now the pine wood when piled with extreme attention to placing the maximum of matter in a given space, weighed 21 pounds per cubic foot, requiring twice and a half the space to stow equal weights with coal; therefore there would be required for dry pine wood five times the space required for equal coal, to produce evaporative effects.

With the most rapid combustion the proportion of clinker was highest and the useful effect from the fuel greatest. When the combustion was most retarded by partially closing the damper, there resulted the greatest per centage of waste and the least useful effect from the fuel. This is accounted for by the want of air, by the stifling effects of the products of combustion retained near the fire, and by the increased quantity of smoke produced in such cases by the diminished temperature of the furnace.

In most of the experiments there was too a deficiency of draft to give the highest evaporative effect. It was observed during some of the trials that the further closing the damper reduced the useful effect of the fuel 9 per cent.

In the combustion of the anthracites, it is important that no large holes be suffered in some parts of the burning mass, and no thick accumulations of coal in others. From the first results a loss of evaporative power, by the refrigerating effects of the air passing through, without its oxygen extricating heat by chemical combination with the fuel. In the second, the masses of fuel being too thick to admit a sufficient supply of air, there results a loss by the carbon not taking up a full dose of oxygen—a portion passing off as *carbonic oxide* instead of *carbonic acid*.

The combustion of the anthracites generally, is effected *solely* by the *contact* of air with the surfaces of their solid masses; hence, the spaces between those surfaces should be as many and as narrow as possible. With bituminous coal, when a large portion of its constituents exist in the furnace in a gaseous state, the presence of holes in the solid fuel is of less importance; for the comparatively large mass of uncombined air entering through them, will be taken up by the fuel filling the upper part of the furnace in a gaseous state.

The arrangement of the boiler in which these experiments were conducted was such, that air of widely varying temperature could be furnished to the fuel. The observed effects were,—1st. By employing air of lower temperature, the rate of *combustion* is increased. 2d. The rate of *evaporation* is diminished. 3d. The gases are delivered into the smoke chimney at a higher temperature. 4th. The

evaporative effect of the coal is reduced.

The experiments upon a mixture of anthracite and bituminous coals established:—that when a coal of high bituminousness was mixed with anthracite, the coking of the former materially agglutinates, not only its own masses, but also those of the anthracite, closing the open spaces of the latter, and preventing the easy access of air; causing the fire to become sluggish. But with a free-burning bituminous coal, the bituminous lumps scarcely cohere, and still less do they adhere to the anthracite. Each ingredient of the mixture retains its distinct evaporative power, the total being the sum of both.

So long as the gases of bituminous coals continue to be the chief materials burned, they keep the solid masses at a black heat, by absorbing into latent heat the caloric, which would otherwise raise the temperature of the solid masses, and render them fit to heat by radiation. Hence it occurs, that even when bituminous coals take fire promptly, they require considerable time to bring the boiler to medium activity.

The experiments seem to prove, that the carbon in coal is the only *available* element of its heating power. Those who have sought to determine the heating power of fuel for practical purposes, by computing the heating power of its hydrogen from the data given by chemists, appear not to have considered, that the hydrogen experimented on by chemists was already in the gaseous state, while in fuel it is either in the liquid or solid form at the commencement of combustion, and is converted into the gaseous state at great expense of caloric, which is rendered latent, and cannot be again made free. The practical value of this loss is also increased, when the products of combustion pass away at a higher temperature than that of the water supplied for evaporation.

In the boiler used for these experiments, an open air-plate was introduced at the furnace bridge. The use of this air-plate *increased the evaporative power* of the unit of combustible matter, but (compared for equal times) *decreased the bulk* of water evaporated.

Other results will become apparent by inspection of the tables.

Results of Experiments on Anthracite Coal. By PROF. WALTER

NAME.	Proportion of grate to heating surface.	Pounds of fuel consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended on the products of combustion, ascertained by comparing total calculated evaporative power of unit of fuel with evaporative power ascertained by experiment.	EVAPORATION.			DENSITY.				
					Cubic inches of water evaporated from initial temperature per hour by one pound of fuel.	Cubic inches of water evaporated from initial temperature per hour by one foot of heating surface.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.
Beaver Meadow, 1st spec.	1 to 26·83	6·69	266·73	10·74	230·75	57·57	9·21	1·61	54·93	52·89	34·07	21·39
Do. do. 2d do.	" "	6·27	372·39	14·91	208·63	50·63	9·88	1·55	56·19	51·40	35·00	26·97
Do. do. 3d do.	" 23·23	4·63	.....	.....	216·64	43·13	9·08	.....	55·54	.....	.....	.....
Forest Improvement	" 26·83	6·52	283·17	13·83	242·86	58·98	10·06	1·48	53·64	44·03	30·75	17·94
Peach Mountain	" "	6·94	240·68	10·89	257·56	64·49	10·11	1·46	53·79	58·09	45·12	22·40
Lehigh	" "	6·93	625·85	26·93	193·02	53·28	8·93	1·59	55·32	46·55	35·35	.....
Lackawanna	" "	6·89	253·73	10·20	237·70	60·33	9·92	1·42	48·89	50·95	36·88	.....
Do.	" 23·23	6·10	253·73	10·20	186·11	48·69	9·65	1·42	48·89	50·95	36·88	.....
Lyken's Valley	" 26·83	6·92	.....	.....	228·74	59·00	9·46	1·39	48·56	52·06	32·75	21·56
Average.....	1 to 26·03	6·43	340·42	14·58	223·00	55·12	9·59	1·50	53·35	50·85	35·70	22·05

ACTION IN THE FURNACE.—In the "Forest Improvement" the clinker was very imperfectly vitrified, not clogging the grates. In the "Peach Mountain" the clinker was thoroughly fused and agglutinated to grate; it ignited with difficulty, but when ignited every part incinerated. In the "Lackawanna" the clinker was imperfectly vitrified and agglutinated. The "Lykens Valley" burnt freely with a considerable clear, yellow flame, of moderate length and brilliancy, but showed no resemblance to caking coal: it did not require a very powerful draught to quicken and sustain combustion.

The use of the air-plate on an average increased the evaporative power 0·43 per cent, but decreased the bulk of water evaporated in a given time 14·90 per cent.

R. JOHNSON. *Made at the U. S. Navy Yard, Washington.*

WASTE.			CONSTITUENTS OF COAL.					TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.			
Per cent. of total waste, ashes, clinker, root, &c.	Per cent. of clinker alone.	Per cent. of ash alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air entering below ash pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.				
11.96	1.01	0.10	1.560	2.380	0.011	7.11	88.94	87°	84°	254°	63	11.94	23	24	Grains of water from 100 cubic inches of gas.	Carbonic acid.	Oxygen	Nitrogen.
6.74	0.60	0.16	0.890	3.600	0.062	5.15	90.36	84	81	266	"	10.50	"	"	0.72	10.193	10.992	78.815
8.10	1.40	....	....	....	....	8.10	....	84	52	277	41	10.48	20	21	0.77	7.844	14.736	77.420
6.97	0.81	0.08	1.790	3.050	0.016	4.41	90.75	86	80	275	63	10.48	23	24	....	....	....	....
6.97	3.03	0.08	1.900	2.960	0.006	6.13	89.02	87	79	292	"	10.50	"	"	0.91	9.767	10.885	79.348
7.22	1.08	0.16	....	5.290	....	5.56	89.15	55	51	287	"	12.84	"	"	1.76	10.836	11.099	78.015
9.71	1.40	0.12	2.120	3.790	0.123	6.35	87.74	77	75	269	"	10.48	"	"	0.69	10.599	10.835	78.566
8.14	1.08	0.12	2.120	3.790	0.123	6.35	87.74	55	49	269	41	11.90	20	21	0.69	10.599	10.835	78.566
12.25	4.40	0.07	0.110	6.790	0.091	9.25	83.84	84	80	265	63	11.48	23	24	....	....	....	....
8.67	1.64	0.09	1.190	3.980	0.052	6.51	88.54	78	70	273	58	11.18	22½	23½	0.81	8.977	12.541	78.482

GENERAL CHARACTERS.—The flame of anthracites is generally short and blue, having but little illuminating power. They ignite with difficulty, requiring a very strong draught, and give an intense, concentrated heat; becoming extinct while a considerable portion remains unburnt. They undergo no intumescence while parting with their volatile matter during combustion.

LOCATION OF THE COAL.—The anthracites of the above table were all from Pennsylvania. The "Forest Improvement" was from Branch, Schuylkill Co.; the "Peach Mountain" was from two miles above Pottsville, Schuylkill Co.; the "Lackawanna" was from Luzerne Co.; the "Lykens Valley" was from Dauphin Co.

Results of Experiments on Free-Burning Bituminous Coal. By PROF.

NAME.	Proportion of grate to heating surface.	Pounds of fuel consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended on the products of combustion ascertained by comparing total calculated evaporative power of unit of fuel with evaporative power by experiment.	EVAPORATION.			DENSITY.					
					Cubic inches of water evaporated from initial temperature per hour by one pound of fuel.	Cubic inches of water evaporated from initial temperature per hour by one sq. foot of heating surface.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.	
Pennsylvania Coal.	Dauphin & Susqueha.	1 to 26.83	6.86	239.61	12.54	238 11	61.22	9.34	1.44	50.54	44.62	32.25	12.45
	Blossburg	" "	7.78	264.50	14.15	247.56	72.17	9.72	1.32	53.05	44.50	30.87	12.06
	Lycoming Creek	" "	6.33	202.18	15.09	235.47	55.52	8.91	1.39	55.38	37.79	34.37	16.29
	Quin's Run	" "	7.29	269.00	11.37	233.88	69.60	10.27	1.33	50.34	37.09	29.70	....
	Karthauss { Different	" 25.81	7.68	....	....	216.47	67.02	8.74	1.28	52.54	47.94	32.75	....
	Do. { varieties	" 25.35	5.63	....	....	193.10	50.54	9.44	1.28	52.54	47.94	32.75	....
	Cambria Co.	" 23.23	6.36	....	....	199.40	58.81	9.00	1.41	53.46	43.19	33.62	7.83
Do.	" 25.35	7.36	....	....	216.64	64.70	9.46	1.41	53.46	43.19	33.62	7.83	
Do.	" 26.83	5.63	....	....	228.23	48.08	9.03	1.41	53.46	43.19	33.62	7.83	
Average.....	1 to 26.23	6.77	258.32	13.29	223.21	60.18	9.32	1.36	52.55	42.52	32.26	12.16	
Maryland (Cumberland) Coals.	N. York & Maryl'd Min. Co.	1 to 26.83	6.28	205.40	15.40	250.19	58.56	9.78	1.43	53.70	37.79	41.75	....
	Neff's	" "	7.86	262.07	18.33	199.59	67.74	9.44	1.34	54.29	37.20	32.12	12.64
	Eastby's "Coal in Store"	" "	6.04	303.47	15.93	253.86	58.26	10.02	1.31	53.47	39.01	29.00	16.68
	Atkinson & Templeman's	" "	7.33	238.93	15.63	268.09	71.86	10.70	1.31	52.92	33.92	31.62	....
	Eastby & Smith's	" "	8.02	171.15	8.96	241.60	63.54	9.97	1.33	51.16	33.57	36.62	24.28
	Average.....	1 to 26.83	7.11	237.21	14.86	242.67	64.99	9.98	1.34	53.11	36.30	34.22	17.67

GENERAL CHARACTERS.—The free-burning bituminous coals ignite readily. They contain but a small portion of matter to be vaporized, and soon come to the temperature of full ignition. The considerable increase which they take in coking, favors the subsequent rapid and effective combustion of their fixed carbon. In some cases, especially when brought very gradually to ignition, their masses of coke scarcely cohere, and the original forms of their lumps are in a measure preserved, but a rounding of the edges and enlargement of bulk clearly distinguish them from the anthracites. They burn with a flame of moderate length, and produce considerable intumescence.

LOCATION OF THE COAL.—The free-burning bituminous coals are from the States of Pennsylvania and Maryland. Of those from Pennsylvania, the "Dauphin and Susquehanna" was from Dauphin Co. The "Blossburg" was from Blossburg, Tioga Co. The "Lycoming Creek" was from Ralston, Lycoming Co. The "Quin's Run" was from Clinton Co. The "Karthauss" was from Karthauss, Clearfield Co. The "Cambria" was from the summit of the Alleghany mountain, near Alleghany Portage Railroad, Cambria Co.

Of those from Maryland, the "New-York & Maryland Mining Company" was from a few miles to the N. W. of the town of Cumberland, Alleghany Co. The "Neff's" was from the neighborhood of Frostburg, above Cumberland. The "Eastby Coal in Store" was from the coal in store mine, very near Cumberland. The "Atkinson & Templeman's

WALTER R. JOHNSON. *Made at the U. S. Navy Yard, Washington.*

WASTE.			CONSTITUENTS OF COAL.						TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.			
Per cent. of total waste, ashes, clinker, soot, &c.	Per cent. of clinker alone.	Per cent. of soot alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air below ash pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.	Grains of water from 100 cubic inches of gas.	Carbonic acid.	Oxygen.	Nitrogen.	Per cent. to total bulk of dry gases, at standard temperature of 60° F. and pressure of 30 inches barom.
16.36	3.50	0.22	0.45	13.55	0.269	11.49	74.24	93°	84°	280°	63	10.50	23	21	1.192	10.240	9.699	80.061	
11.20	3.40	0.33	1.34	13.93	0.853	10.77	73.11	86	82	302	"	11.94	"	"	0.795	9.768	10.986	79.249	
16.92	3.26	0.37	0.67	13.81	0.030	13.96	71.53	85	83	286	"	11.40	"	"	1.017	9.655	11.292	79.053	
8.94	1.31	0.36	0.84	17.57	0.102	8.41	72.79	80	77	291	"	11.40	"	"	0.575	10.338	10.211	79.451	
7.89	3.66	....	1.28	17.95	1.580	7.00	73.77	53	52	289	41	11.40	22	23					
7.89	3.66	....	1.28	17.95	1.580	7.00	73.77	72	68	266	"	8.15	22	"					
9.75	3.48	....	2.46	19.02	1.500	9.15	69.37	58	53	298	"	9.90	20	21					
9.75	3.48	....	2.46	19.02	1.500	9.15	69.37	71	67	266	"	9.37	22	23					
9.75	3.48	....	2.46	19.02	1.500	9.15	69.37	53	44	256	63	11.94	23	24					
10.17	3.10	0.32	1.17	16.02	0.722	10.13	72.47	72	68	282	53	10.67	22	23	0.895	10.000	10.547	79.453	
12.71	5.43	0.40	1.79	12.31	....	12.40	73.50	92	77	294	63	9.90	23	24	2.177	11.394	9.596	79.016	
10.96	4.53	0.34	2.45	12.68	....	10.34	74.53	62	55	336	"	13.00	"	"	0.810	9.981	10.778	79.241	
8.39	1.33	0.45	0.67	14.98	....	8.08	76.26	92	80	277	"	11.94	"	"	1.342	8.586	10.840	80.614	
7.96	2.13	0.50	0.45	15.53	....	7.33	76.69	87	79	308	"	11.90	"	"	1.755	10.429	11.262	78.309	
9.69	3.05	0.27	0.89	15.52	....	9.30	74.29	71	63	299	"	12.84	"	"	0.720	16.019	8.398	75.583	
9.94	3.30	0.39	1.25	14.20	....	9.49	75.05	81	71	305	"	11.92	"	"	1.360	11.282	10.166	78.552	

was from the eastern slope of Dan's Mountain, near Cumberland. The "Eastby & Smith's" was from the same mine as the "Eastby Coal in Store.

ACTION IN THE FURNACE.—The "Dauphin & Susquehanna" ignites easily; its gas burns with a bright yellow flame. In coking, the masses agglutinate slightly, retaining to some degree the original forms. The "Blossburg" ignites readily; it gives a dark brown clinker, considerably agglutinated, and not remarkably porous. In the "Karthaus" the clinker is porous and in small fragments, agglutinating slightly. In caking rapidly this coal discharges gas copiously, and intumesces strongly into a porous coherent mass. The "Cambria" ignites rapidly, and affords an intense heat, making but little smoke, and forming a slightly coherent coke in burning; its clinker cements into large porous masses.

The "New-York & Maryland Mining Co." ignites readily, and burns with a deep red flame of moderate size, agglutinating while coking into tolerably solid masses. Its clinker is in large spongy masses. In "Atkinson & Templeman's," the clinker is in small fragments, and shows no tendency to adhere to the grates. In the "Eastby & Smith's," the clinker is imperfectly vitrified.

The use of the air-plate on an average increased the evaporative power 2.13 per cent., but decreased the bulk of water evaporated in a given time 2.68 per cent.

*Results of Experiments on Bituminous Caking Coals, from the Eastern Coal Field of
at the U. S. Navy Yard,*

NAME.	Proportion of grate to heating surface.	Pounds of fuel consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended on the products of combustion ascertained by comparing total calculated evaporative power of unit of fuel with evaporative power as ascertained by experiment.	EVAPORATION.			DENSITY.				
					Cubic inches of water evaporated from unit of fuel at temperature per hour by one pound of fuel.	Cubic inches of water evaporated from initial temperature per hour by one sq. foot of heating surface.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.
Barr's Deep Run	1 to 26-83	7-60	339-13	22-05	222-51	61-33	9-02	1-38	53-17	44-86	33-50	....
Crouch & Snead.....	" 24-59	7-13	.....	.....	205-61	57-26	8-34	1-45	53-59	40-92	29-87	25-51
Midlothian (900 ft. shaft) average	" 26-83	8-68	223-99	13-94	205-39	66-44	8-58	1-44	50-52	53-51	43-37	5-74
Creek Company.....	" "	8-60	283-17	19-95	212-66	68-13	8-42	1-32	46-50	56-00	39-50	14-33
Clover Hill.....	" 24-28	5-84	.....	.....	161-07	38-21	7-68	1-29	45-49	53-81	44-62	9-20
Chesterfield Mining Co. .	" 26-83	8-46	385-88	23-81	210-02	66-61	9-00	1-29	45-55	47-29	37-62	22-70
Midlothian average	" 24-56	6-68	.....	.....	193-16	55-83	8-30	1-29	54-04	53-80	37-50	19-06
Tippecanoe	" 24-90	7-37	231-90	18-23	168-46	48-58	7-75	1-35	45-10	57-44	43-37	5-54
Midlothian (new shaft)...	" 26-83	7-60	286-45	15-08	214-70	61-63	8-75	1-33	47-90	....	....	5-46
Midlothian screened.....	" "	6-24	260-36	13-67	202-63	46-29	8-95	1-28	45-72	53-40	39-37	4-91
Average.....	1 to 25-93	7-42	283-70	18-11	199-62	57-03	8-48	1-34	48-76	51-23	38-75	12-49

GENERAL CHARACTERS.—The Virginia bituminous caking coals burn with a long flame, and much smoke, giving an intumescent, coherent coke, preserving nothing of the original form of the coal.

LOCATION OF THE COAL.—The "Barr's Deep Run" was from near Richmond; the "Crouch and Snead" was from the line of the Kanawha Canal, 12 miles from Richmond; the "Midlothian (900 feet shaft) average" was from 13 miles west of Manchester; the "Creek Company" was from Chesterfield Co., south side James River, 12 miles above tide water; the "Clover Hill" was from the Appomattox River, 20 miles above Petersburg; the "Chesterfield Mining Company" was from Chesterfield Co., 12 miles from Richmond; the "Midlothian average" was from 13 miles west of Manchester; the "Tippecanoe" was from near Petersburg; the "Midlothian (new shaft)" was from 13 miles west of Manchester, and the "Midlothian screened" was from the same place.

ACTION IN THE FURNACE.—The "Barr's Deep Run" has its clinker in large, black, porous masses, evincing much fusibility, glazing and encrusting the shale and other foreign matter mixed with it; it manifests some tendency to spread into sheets, but does not attach to the grates with much force. The coke when produced rapidly is intumescent. The "Crouch & Snead" in coking emits a red, smoky flame, and loses every trace of its original form; swelling very much, and leaving a jet black, shining, friable mass: its clinker is much vitrified. The "Midlothian (900 feet shaft) average" has its clinker in

Virginia, in the Neighborhood of Richmond. By PROF. WALTER R. JOHNSON. Made Washington.

WASTE.			CONSTITUENTS OF COAL.					TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.							
Per cent. of total waste, ashes, clinker, soot, &c.	Per cent. of clinker alone.	Per cent. of soot alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air entering below ash pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.								
11.07	4.75	0.42	1.785	19.782	....	10.475	67.958	60	560	3290	63	12.83	23	24	1.000	Per cent. to total bulk of dry gases, at standard temperature of 60° F. and pressure of 30 inches barom.	Carbonic acid.	Oxygen	Nitrogen.			
14.34	5.37	0.91	1.785	23.959	0.427	14.280	59.976	66	64	307	"	12.41	22	23	0.875					7.892	13.207	78.901
10.70	6.47	0.41	1.172	27.278	....	10.467	61.083	70	63	349	"	12.80	23	24	1.021					11.208	9.942	78.850
8.64	4.42	0.55	1.460	29.678	2.890	8.572	60.300	82	77	338	"	11.90	23	24	0.980					10.050	12.107	77.843
10.60	3.86	1.11	1.339	31.698	0.514	10.132	56.831	62	65	302	41	8.00	21	22	0.980					6.724	13.189	80.087
9.07	4.20	0.67	1.896	30.676	1.957	8.634	58.794	80	77	344	63	11.48	23	24	1.060					11.142	7.775	81.083
14.83	8.82	0.62	2.455	29.796	0.058	14.737	53.012	76	72	289	41	9.60	24	25	0.840					9.600	10.731	79.669
9.72	4.03	0.90	1.841	34.165	0.377	9.374	54.620	62	59	302	"	9.90	21	22	0.400					10.460	8.954	80.586
10.26	4.21	0.50	0.670	33.490	2.286	9.440	56.400	76	67	306	63	11.90	23	24	0.832					9.582	10.843	79.575
10.27	3.33	0.84	1.785	34.497	0.202	9.655	54.063	69	66	298	41	8.80	23	24								
10.95	4.95	0.69	1.620	29.50	1.090	10.580	58.300	70	66	316	54	10.96	22½	23½	0.832							

lumps of a large size, black, and porous, with some tendency to spread into compact, tenacious sheets, with some tendency to adhere to grate. When the combustion of this coal is unimpeded by clinker, it is free, with a large, red, smoky flame; the clinker offers great obstruction to combustion. The coke of the "Creek Company" coal intumesces and coheres firmly. The "Clover Hill" coal in burning falls into small lumps, which fall through the grate in large quantities. The "Chesterfield Mining Company" coal makes a large flame and hot fire, yielding a coherent coke. The clinker is in large masses, prone to spread into sheets. The "Midlothian average" has its clinker in large, porous masses, clogging the grate much. The "Tippecanoe" coal ignites readily, burns freely, with a large, dense, red flame, and agglutinates while coking. The "Midlothian (new shaft)" ignites rapidly, and burns with a long, dense, deep red flame, agglutinating into a rather solid, moderately intumescent mass, requiring some efforts to break it. Its clinker is black, compact, and heavy; in large sheets very fusible, and tending to adhere to grate. The "Midlothian screened" has its clinker in small lumps; it cokes completely, running into large masses, which cohere firmly, giving off a dense flame, with much smoke.

The use of the air-plate on an average increased the evaporative power 1.96 per cent., but decreased the bulk of water evaporated in a given time 1.48 per cent.

(To be continued.)

NEW HAVEN WATER METER. INVENTED BY JOHN S. BARDEN.

Fig. 1.

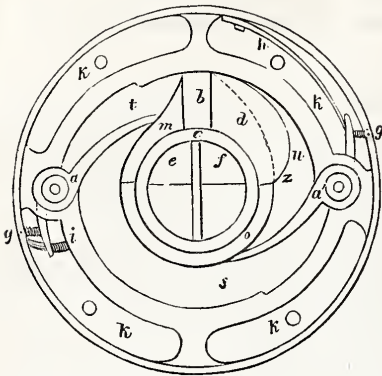
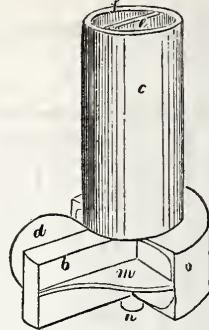


Fig. 2.



We copy from the description of the inventor:

Fig. 1. Perspective view of the interior of the cylinder with the top removed, showing the valves *a* and *a'*, the piston *b*, the can *d*, the end of the piston shaft *c*, the back slide *m*, the inlet pipe *e*, the outlet *a*, exhaust pipe *f*, the regulating screws *gg*, the valve springs *h*, operating on the valves, so as to hold them closely against the cylinder *o*: one of these springs shown as a spiral and the other as a flat spring (either of which may be used). The spaces *k* between the chambers of the cylinder and its periphery allow for the working of the springs, and for the passage of the bolts, securing the heads of the cylinder. The hinge valves can be substituted by slides, the upper and lower edge of which are to be inserted in a groove in both heads of the cylinder, said slides to be thrown out against the cylinder *o* by spiral or other springs. [The inside of the cylinder may be hollowing or straight.]

Fig. 2. Perspective view showing the piston *b*, the can *d*, the back slide *m*, the hollow shaft of the piston *c*, the inlet *e*, the outlet *f*, the piston, or lower bearing of the piston shaft *n*, and the inner cylinder *o*.

The above machine may be constructed of any suitable material and of such size and dimensions as is required for its use, viz.: Water Meter, Water Wheel Rotary Pump, or Rotary Engine. [The

hollow shaft may extend through the revolving shaft.]

For a Water Meter, as in the above figures, valves *a* and *a'*, as in figure 1, with the fulcrum of the valve in a box in the periphery of the cylinder, and so shaped that when passing over the piston they fit exactly into the cavity and complete the circle. A back spur passes from the valves through slots in the valve boxes so as to come under the regulating screws *gg*. The piston *b* is a block of metal fitted to the chamber which revolves around it. The can *d* may be made of the shape in the drawing, or instead, a friction wheel may be used, or a perforated plate may extend from the inner cylinder to the extremity of the piston, the valves to be sufficiently tight to divide the cylinder into two water-tight chambers; the bearing sides of the inner cylinder are also made or packed in a similar manner, as also the bearing of the piston shaft, where it passes through the cylinder head, also the bearing side of piston *b*. After the piston shaft (fig. 2) is put in its place, and the cylinder heads properly secured, the machine is so placed that the piston, piston shaft, and all connected with them, are firmly held; while the cylinder and cylinder shaft are fitted to revolve easily in a proper box or bearing, the water pipe is securely attached to the inlet *e* of the piston shaft, and the water, having a sufficient head, is permitted to enter the cylinder. The water flows into

the cylinder at *e* and the chambers *s* and *t* are filled; the water still pressing on, the valve *a'* is closed firmly against the periphery of the inner cylinder, and the piston *b* being stationary, the outer cylinder is forced to revolve in the direction from right to left, until the ends of the valves are both firmly on the periphery of cylinder *o*, thus forming and measuring an exact chamber, being one-half of the interior of the cylinder, minus the space occupied by the valves. As the cylinder passes this point, the valve on the left being closed rests on the periphery of the inner cylinder, while the opposite valve rises on the cam *d*, and the water in the chamber *s* is forced out through the passage of the piston shaft *f*. As the cylinder continues to revolve, the valve is turned up on the cam until it takes the position shown by the white line *r*, and completes the circle as it is carried over the piston.

By calculating the number of cubic inches in the interior of the cylinder, minus the space occupied by the valves, the quantity of water that flows through at each revolution is obtained, and by attaching the ordinary dial work of a clock, properly geared to the cylinder or cylinder shaft, with an index and dial plate, the quantity of water that flows through the meter can be always ascertained with certainty.

From our London Correspondent.

LONDON, July 4th, 1851.

My Dear Sir,—The whirl of "the Exhibition" is enough to drive the memories of each day fairly out of one's head, to say nothing of those of a month. I left off in my last with a sketch of the progress in looms which has been made in England, as nearly as I can remember; but since then I have met with some very curious facts in the history of flax-cotton; and, as I judge from the American papers that that subject is still exciting some interest among you, I shall proceed to give you the result of my examinations. In a work entitled "Elements of the Art of Dyeing and Bleaching, by C. L. and A. B. Berthollet, translated by Andrew Ure, M.D., F.R.S., first published in England in 1824, 2d edition 1841," you will find the following history of flax-cotton:—

Page 111. "Since flax and hemp present the same properties in reference to dyeing, they are usually confounded together in this work. If cotton be an important object to our industry, flax and hemp merit peculiar attention, both as a territorial production, and as the most extensive source of employment to the people."

P. 113. "In a more complete solution of the coloring particles, is founded a process, published by the Prince de Saint Sever, to obtain fine dressed hemp. He recommends to put the tress of hemp in a ley, made by the solution of two parts soda to one of lime, next to impregnate it with soap, to digest for some time, wash well and hackle it.

"Several processes analogous to the preceding have since been published, under the veil of mystery. Their results had an imposing aspect. But experience has sufficiently shown, that, besides the expense which they incurred, these processes increased the proportion of tow, and the yarn obtained had less durability, and little advantage in beauty, over the yarn from the unprepared hemp. Bralle, however, hit upon a process, by which a large quantity of hemp may be steeped in a few hours, with the advantage of freeing the stems from their bark without any waste, of preserving the length of fibre, and consequently, of producing much less tow. The process of Bralle, whose efficacy has been verified at the Conservatoire-des-Arts, on hemp intended for cordage and sail-cloth, has just been published by order of Government. It consists in keeping the hemp plunged for two hours in water, containing one-fortieth part of soft soap in solution, which is maintained at a temperature of from 194° to 200° F. A mode has been discovered, of giving to the dressed hemp, and even to the tow, a division and fineness which qualify it for the same spinning process *as cotton*, so that, with this preparation alone, or *mixed with cotton*, stuffs may be made which have a greater value than those made from hemp in its natural state. Marcandier seems to have been the first who engaged in this process. He recommends to give to the tow—1stly, the preparation which he prescribed for the dressed hemp. In carding it like wool, a fine medullary white substance is obtained, for which

no use was heretofore known. It can be employed by itself in this state, not only to make fine cotton, but it may be spun into a very fine thread. It may likewise be mixed with cotton, wool, silk, and even hair; and the yarn resulting from these different mixtures, furnishes, in its numberless variety, materials for new trials, interesting to the arts and to several manufactures. This object has engaged much attention in Germany. Hermstadt quotes several works which treat of it, &c., &c."

P. 157. In treating of hemp and flax, we have described the processes by which it has been attempted to give them the appearance of cotton. Chlorine may be beneficially employed for this purpose.

"Pajot-des-Charmes seems to have been the first who made this application. He says 'It is to be remarked, that the tow of flax or hemp, proceeding from the fibres thus bleached, cut, if it be too long, and then carded, singularly resembles the cotton of Siam, which is known to be the shortest and most common of the cottons of commerce. When it is well carded, their difference cannot be discerned, nor is it possible to distinguish between them in spinning. I took occasion to have some of it woven at the end of a web, and it would have been taken for real cotton. I also employed some of it for candle-wicks. It would doubtless be very interesting to know all the benefits which could be derived from this application of chlorine.' Some time after, but without knowing what has now been detailed, a description of operations made in the laboratory of the Polytechnic School to accomplish the above object, was published in its Journal. But 'Giobert' has given us more extended and more exact observations, capable of directing this new branch of art, which may possibly acquire some importance. 'The process which I have followed,' says he, 'is, in general, the same with what Berthollet has just proposed; but with this difference, that in the trials made at the Polytechnic School, long fibres cut into fragments of $2\frac{1}{2}$ inches, were employed, whereas I employed merely tow at 3 sous per lb. The process is the same, and consists of the following operations:—1st. The fibres are covered with water, and left in it for three or four days, after which they are

boiled in water. 2d. They are then treated with a ley, and then passed into chlorine, operations which should be repeated alternately four times. 3d. The fibres are now placed in a bath of water, charged with one per cent. of sulphuric acid, and left in it for half an hour. 4th. The fibres, when taken out of this bath, are washed very carefully, and plunged in soap-water. They are then stretched out without wringing on hurdles, and left to dry. The different observations which we shall make on this process, are the result of operations on a large scale, which have brought into the market cottony cloth, and bales of this hemp cotton, which were not distinguished from ordinary cotton. From these results various ameliorations have suggested themselves." (I omit the next five paragraphs, as being principally on chemical points, and turn to the sixth and last, as follows:—)

P. 161. "The cotton produced from hemp by the preceding operations, whatever care may have been bestowed, is always different from ordinary cotton, and it is easy to distinguish it. The fibres preserve a peculiar glitter very different from the dead white of cotton. This lustre is sufficiently agreeable, and may possibly be sought after for several objects of manufacture, but it is a property of cotton, and must therefore be regarded as a defect in our efforts to imitate ordinary cotton. I have discovered only one method of remedying it, which consists in mixing by the cards, 10 to 15 per cent. of common cotton with that from the hemp. The cotton yarn made by this means is no longer distinguishable from ordinary cotton yarn."

And now, "good-bye" to the Chevalier Claussen; I may have bored you with him, but I wished to keep my countrymen from spending time and money on an "exploded idea," and this must be my excuse. Messrs. Paxton and others are now agitating the question of the future of the Crystal Palace, and there can be little doubt of the result. The treasures it holds may be scattered to the ends of the earth, but the magnificent structure which has been reared to contain them, will, I believe, be left as a monument of the "World's great Congress." Free-traders and fanatics may meet on the banks of the Rhine, and pass yards of

resolutions; apostles of freedom and peace may foment intestine quarrels, in any nation whose good-nature may tolerate them; but here, in the world's metropolis, stands a living realization of industry and progress.

No ultra schemers moved hand or foot in its erection, no visionary day-dreams gave birth to the idea; but, the practical result of honest good sense and judgment, its memory will live, and its influence be felt, when even the glass and the iron which compose it shall have crumbled back to their mother earth; and when, in the westward progress of empire, the seat of the world's civilization shall be established on the Columbia or the Sacramento, the traditions of the Crystal Palace will tower far above the pyramids or the Colosseum. S. W.



GWYNNE'S NEW MOTIVE POWER.

There is a class of persons in our midst, of whom we conceive it to be our duty to caution the public—men whose business it is by specious representations of the value of certain inventions of their own, to induce others alike ignorant as themselves of mechanical matters to lend their aid in bringing to the knowledge of the public, great discoveries which are to result in their mutual and everlasting benefit.

We will illustrate the operations of these inventors by a short anecdote, assuring our readers that our experience of these people is a matter of almost daily occurrence; and the fact that the projectors are, in many instances, notoriously ignorant of all the laws of mechanics, appears to strengthen their claim to be listened to with attention as “*practical*” investigators and discoverers in the great field of mechanical science.

Application was lately made to the Commissioner of Patents for the great seal of the United States to be appended to an invention purporting to be of “great value.”

Commissioner—“I cannot issue a patent for this, my dear sir, for, although I will grant it to be, so far as my knowledge goes, entirely original, yet it can be of no possible value to any human being.”

Inventor—“Well, now, I guess it's good for me to ‘sell rights.’”

A great noise is being made just now of a new motive power, and we select this for exhibition from among the crowd of “valuable” inventions, for the reason that the scale upon which the owners are operating, is calculated to do mischief unless a warning voice be raised in season.

And we do this at the risk of being judged by the learned in mechanics as one fighting windmills, which, by the way, the machine so far resembles, that the real moving power is designed to be air or gas—great quantities of which have already been expended without as yet producing any motion beyond the sale of a few of the “Rights;” some \$800,000 worth being, as we are informed, yet on hand. That some have been sold, however, is a sufficient reason for our breaking silence.

We copy from the circular of the Inventors:

Sawyer and Gwynne's Pressure Engine for producing Motive Power by Static Pressure, using Centrifugal Force to perpetuate a vacuum, which represents the Nominal Power of the Engine.

The following questions applicable to the power and resistance of this engine were submitted to R. H. BULL, Esquire, Professor of Mathematics, and were returned with the answers:

NEW YORK, May 8, 1851.

*Richard H. Bull, Esq.,
Prof. of Mathematics.*

DEAR SIR:—We take the liberty to submit for solution the following questions, and solicit your earliest reply.

Very respectfully,
N. SAWYER,
J. STUART GWYNNE.

1. We have a wheel weighing 531

pounds, the weight collected in a circle of 16 inches diameter. What amount of power, applied $1\frac{3}{4}$ inches from the centre, will be required to cause it to revolve 25 times in 10 seconds. Answer—166 pounds.

2. What will be the centrifugal force when brought up to the velocity. Answer—2716 pounds.

3. What power will be required to produce the motion as above if applied parallel to the axis of a screw of the following dimensions: Hypotenuse of the angle 10 inches, perpendicular 4 inches, base 9.17 inches. Answer—452 pounds.

NEW YORK, May 10, 1851.

GENTLEMEN:—I have examined your questions, and return them with the answers annexed to the questions.

Respectfully yours,

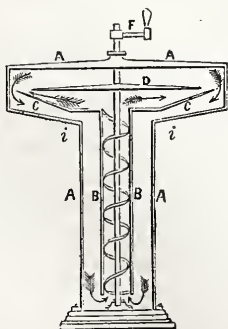
RICHARD H. BULL.

To Messrs. Sawyer & Gwynne.

The two first questions require the amount of force necessary to revolve a wheel of given weight and dimensions, also the centrifugal force due to the velocity.

The third question requires the amount of force to be applied to the screw to produce the motion as above.

All these questions apply to the accompanying diagram, where A, A, A, A is a strong cylinder capable of resisting any required pressure, and filled with quicksilver to the height of i .



c c, basin or wheel for evolving centrifugal force, and also filled with quicksilver to the bottom of the disk D, covering the basin.

B B, cylinder inclosing the screw.

A valve is attached to the disk, and rests on the rim of the basin.

F. crank.

The quicksilver in the basin or wheel is supposed to be 26 inches in diameter and two inches thick, weighing 531 pounds.

The screw is four inches diameter, and of any required length, with a thread of four inch pitch, and the space between the threads four inch broad and one inch deep. The basin, disk, valve, screw, and cylinder B B are all connected and revolve together, and, according to Professor Bull's demonstrations, 166 pounds (allowing for the weight of the wheel) applied to the crank F, will produce 25 revolutions in 10 seconds, and the centrifugal force of the quicksilver in the basin will be 2716 pounds; and it is clear that the equilibrium in the cylinder will be destroyed to the full amount of the centrifugal force, and a vacuum would be formed at the upper end of the screw, if no quicksilver was permitted to pass up and supply the place. Now, whatever may be the size of the vacuum, it cannot, under the ordinary pressure of the atmosphere, be worth more than 15 pounds to the inch, and as the diameter of the cylinder B B is four inches, and the area $12\frac{1}{2}$, it is clear that the vacuum of 2716 pounds can only be made available for $187\frac{1}{2}$ pounds; and deducting for the end of the shaft and thread of the screw, we have but 10 inches against which the pressure can act.

Now, to make this pressure available to the extent of the centrifugal force, we must pump air or gas into the air chamber c c, until the pressure on the surface of the quicksilver is 271 pounds to the inch; this, multiplied by 10, shows 2710 pounds pressure upon the first thread of the screw at the lower end. Professor Bull has further shown that 452 pounds against the thread of the screw is equal to 166 pounds direct force, leaving a clear surplus of 2254 pounds more than is required to turn the wheel.

It must be recollected that 166 pounds direct pressure, or 452 pounds against the thread of the screw, is the force required to bring 531 pounds from a state of rest to 25 revolutions in 10 seconds, and the weight of quicksilver received in at the centre and discharged at the valve E E (allowing no slip on the screw), will be just 541 pounds in 10 seconds. It is clear, therefore, that any force against the lower

end of the screw exceeding 452 pounds is surplus over and above the force required to turn the wheel, and may be applied to other purposes.

It may be proper to add, that the pressure of the quicksilver against the lower end of the screw will cause it to rotate upon the principle of the propeller screw reversed.

A force equal to 166 pounds applied $1\frac{1}{4}$ inches from the centre will be required for the purpose of overcoming the inertia and friction equal to elevating 166 pounds 135 feet high per minute; and as a horse power is estimated to raise 150 pounds 220 feet high per minute, 166 pounds raised 135 feet high requires $\frac{3}{4}$ of a horse power, which being deducted from 6,482, gives 5,732, or nearly $5\frac{3}{4}$ horse powers, as the effective force of the engine.

We have not revised Professor Bull's calculations, as we conceive they have nothing to do with the question of the value of the machine, which would prove all its projectors assert of it, were there such a law of matter as they claim to have discovered, viz., "*A centrifugal force or power as independent in itself as the force of gravity.*"

To our own mind it appears absurd to reason with a man who asserts that upon turning a wheel, by any means whatever, a power is *generated* greater than that expended; in other words, the effect greater than the cause; but as otherwise sensible men have failed to perceive the fallacy in the claims of the inventors of this machine, we beg leave to call their attention to the following well-known plans for perpetual motion, equally plausible with the one under consideration; for although the inventors of the latter deny its claim to the name of perpetual motion, it must, nevertheless, take its rank with these projects.

Messrs. Sawyer and Gwynne's machine is so simple that one may well be surprised to learn that it has never been built for trial; although by their own statement, *twenty-five thousand dol-*

lars have been expended in bringing it to perfection, an outlay of \$100 would be sufficient to test its value.

We condense the following from Dr. Hutton's translation of Montucla's edition of Ozanam's *Recreation in Science*, published about the year 1770.

Fig. 1.

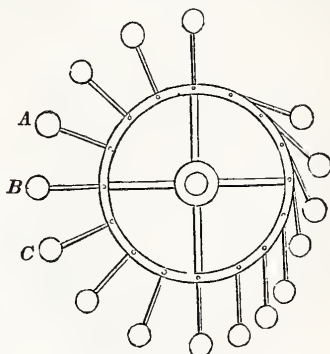


Fig. 1 represents a large wheel, furnished at equal distances on its circumference with hinge levers, weighted at their extremities, which, when turning in the direction from right to left are thrown out, and remain in the direction of the radii; but after passing the lowest point of the wheel, hang vertically. It would appear that the leverage of the weights A, B, C, will always cause the wheel to turn, by reason of the preponderance of weight on one side of the wheel; yet experience has demonstrated that the wheel will not go; and aside from this, it may be proved that the centre of gravity of all the weights will pass through the axle of the wheel in some one position, at which it will of course rest.

Fig. 2 represents another form of the same thing. In a cylindrical drum, balanced on its axis, are formed channels, as shown in the figure, containing each an equal quantity of shot or quick silver. Upon turning the wheel, the weight will be thrown to the circumference on one

side, and towards the axle on the other, thereby continuing the motion of itself.

Again, in fig. 3, the machine is made to consist of hollow arms, forming a wheel, and balanced at the centre as before. The extremity of each arm is provided with a kind of bellows, the movable top of which is weighted, to shut it in one situation and open it in another.

Fig. 2.

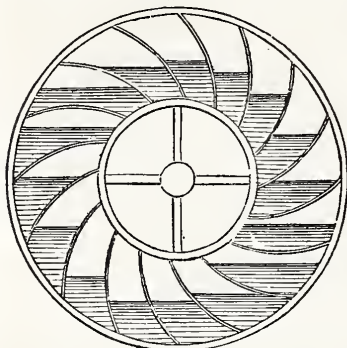
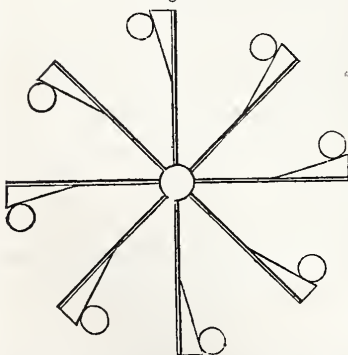


Fig. 3.



The opposite bellows alone communicate, and one of each (or half of them) are filled with quicksilver. It is evident that, on one side, the open bellows will receive the quicksilver, and the opposite bellows will be shut, throwing a preponderance of weight on one side of the wheel, which will consequently turn in that direction.

A description of a machine, in which

the power resided in bellows, alternately filled with, and emptied of, quicksilver, may be found in the "Journal des Sçavans," so long ago as 1685. It made a great noise at the time, (but, as well as the above described machines,) was found worthless.

We warn our young readers against embarking in any speculation, resting as a basis upon the *mechanical generation of power*. Sawyer & Gwynne's new motive power is of this description, and is worth full as much as the above described perpetual motions.

This warning is not uncalled for, as the publication of the following circular will show.

"Certificates are to be issued for the sale of Twenty Thousand Horse Powers of Sawyer & Gwynne's Pressure Engine, which are to be sold at \$40 for each horse power; \$10 of which is to be paid to the Patentees, leaving \$30 on each horse power in the hands of the holders of the Certificates as profits. These Certificates are issued to said purchasers on the payment of 30 cents on each horse power, or one per cent. on the profits referred to.

"Office, 300 Broadway.

"NEW-YORK, April, 1851.

[Signed] "M. STARBUCK, Ag't."

PATENTS.

List of Patents (with claims annexed) which issued from the United States Patent Office from the 6th day of May, 1851, to the 3d June, 1851, both inclusive.

TO JONATHAN SULLIVAN, of Lexington, N.C., for *Improvement in Straw Cutters*. Patented May 13, 1851.—I claim, in combination with the toothed grooved cylinder and curved stationary knives, the clearers, arranged and operating as shown.

TO JOHN R. ST. JOHN, of New-York, N. Y., [assignor to James Renwick, Geo. F. Barnard and Ewd. B. St. John, of New-York, N. Y., Trustees of the St. John's Compass and Log Manufacturing Co.,] for *Improved Method of Supporting the Vanes of Aquatic Velocimeters*. Antedated Dec. 27, 1851. Patented May 13, 1851.—I do not intend to claim any of the parts herein described, as taken separately; all are well known and in common use: but

I claim attaching the disc or plate to the sliding frames, one of which frames carries the shaft of the paddle-blades, when said frame and plate are fitted to be lowered into or raised out of a tube, in such a manner that when in place for use, the plate prevents any indirect current of water from ascending into or descending out of the tube, to disturb or destroy the accuracy of the instrument, leaving the paddle-blades subject only to the direct action of the vessel's progress through the water.

TO RUFUS BIXBY, CYRUS S. BIXBY, and JOHN GARST, of Dayton, Ohio, *for Improvement in Planing Machines*. Patented May 13, 1851.—We claim the employment on one or both sides of the grooving cutters, of a chain or band applied and operated in the manner described.

TO CHARLES HOSKYNs, of New Orleans, La., *for Improved Apparatus for relieving the helmsman from the shock of the rudder*. Patented May 13, 1851.—I claim the combination of two sets of pawls between which a wheel is placed, loose upon the shaft, having an end-wise motion thereon, by means of the male and female screw; said wheel being provided with a hub, so fitted, as to disengage the pawls when the hub arrives at the limit of its end play in either direction; the result being that the rudder secures itself through the agency of the pawls, and is unlocked so as to be free to move in either direction, by the first motion of the same wheel, which afterwards moves the rudder. In other words, I claim the combination of the hub, secured to the wheel, the male and female screws, or their equivalents, and the ratchet and pawls, for the purposes described.

TO GEORGE FABER, of Canton, Ohio, *for Improved Apparatus for indicating the height of water in steam boilers, etc.* Patented May 13, 1851.—I claim the combination of the chamber with the boiler or other vessel, in which the height of fluids is to be measured by means of tubes so formed and attached, as to act as springs, to indicate the weight of the water at any time within said chamber, in the manner herein set forth.

TO JAMES M. CLARK, of Lancaster, Pa., *for Improvement in Flouring Apparatus*. Patented May 13, 1851.—I claim, first, the arrangement of the "hopper boy," revolving on the same centre as the stone and the chamber beneath the stone, by which the flour is cooled as it is conveyed to the centre opening of the bolt.

Secondly, I claim the annular or endless conveyors for carrying the flour, &c., in the several annular chambers, to the spouts.

Third, I claim, in combination therewith, the air passage for returning the particles of flour which would otherwise escape, to the centre hole of the floor of the bolting chamber, to be drawn in again by the draft, in the manner set forth.

TO EZRA RIPLEY, of Troy, N. Y., *for Crane Hinge of Doors, Shutters, etc.* Patented May 13, 1851.—I claim the crane door-hinge, constructed in the manner and for the purpose as set forth.

TO ADOLPH F. AHRENS, of Philadelphia, Pa., *for Improvement in Setting Teeth*. Patented May 13, 1851.—I claim attaching artificial teeth to a plate in the roof of the mouth, by means of a wedge-formed recess in the tooth, and a pivot of corresponding shape, soldered or otherwise, attached to the plate, when the union of the two is effected, by the use of platinum and tin or solder, for the purposes specified.

TO ADOLPH F. AHRENS, of Philadelphia, Pa., *for Improvement in Setting Teeth*. Patented May 13, 1851.—I claim securing artificial teeth to a plate in the roof of the mouth by means of a rebate in the inner face of the tooth, and a slide fitting the same and soldered or otherwise attached to the plate in the mouth, for the purpose described.

TO JOSEPH GRANT, of Providence, Rhode Island, *for Improvement in Brick Presses*. Patented May 13, 1851.—I claim, first, the form of the pressing plates thicker at one edge than the other, as shown.

Second, the motion of the followers or plungers [three] by rollers moving in fixed grooved channels [two] and acted upon by revolving cams [two], producing a drop movement, and operating as herein explained.

Third, propelling the machine forwards by means of wheels keyed on the mould cylinder shaft, for the purpose of depositing the bricks, as made, in regular layers for drying.

TO MARTIN RICH, of Fairfield, Wisconsin, *for Improvements in Saw Mills*. Patented May 13, 1851.—I claim, first, the tightener and key, and the manner in which they are used in tightening the dogs, as herein set forth.

Second, I claim the movable arm to regulate the thickness to be sawed when changing from one thickness to another in the same log, without taking the dog out of the log.

Third, I claim placing the second dog upon the main plate, and adjusting it by the bolt and key, constructed in the form and manner and for the objects and purposes set forth.

No other part of the said described dogs do I, in this my specification, claim as new or original, excepting such as above enumerated.

TO FREDERICK LEYPOLDT, of Philadelphia, Pa., *for Improvements in Scarificators*. Patented May 20, 1851.—I claim the use of the said hollow pivot, lever, and slide racks, combined and arranged as described, secured in their proper places by the plate and screws, and operating in connection with the trigger and springs.

TO JAMES W. OSGOOD, of Columbus, O., *for Improved Compound Coupling for Hose or Pipes*. Patented May 20, 1851.—I claim the manner, if desired, of keeping the several threads or screws always in contact, whether the coupling be formed or disconnected, for obtaining the advantages set forth, by the employment of an interior box, situate in an outer box, and having a loose ring or collar, or its equivalent, on it, in combination with a washer, connecting nut, and box, formed with lips for locking the coupling, the seve-

ral parts constructed, fitting and operating together.

To NELSON PLATT, of Ottawa, Ill., for *Improvement in Smut Machines*. Patented May 20, 1851.—I claim, first, in connection with a close case surrounding the machine, the arrangement of the fan, as herein described, in the annular space surrounding the beaters, between the outer case and the fluted cylinder; and at the entrance of the pipe through which the dust is discharged, so that the currents of air will set into the machine through any cracks or openings in the same, from the room in which it is placed, by which means the escape of pulverized dust or smut, into the room, is effectually prevented. Secondly, I claim the arrangement of the air chamber, having currents of air passing through and across it, between the upper part of the beater and the space through which the descending current of air passes to the fan, for the purpose of collecting any portion of the grain, accidentally thrown out of the scouring cylinder by the blast or beaters, and returning the same, so that it may pass through the machine with the rest of the grain in the proper direction. Third, I claim the conical, or shield, for the purpose of protecting the conical screen below it from abrasion by the descending grain, and at the same time keeping the pores of the screen open, for a free passage of air through it into the fluted cylinder. Fourth, I claim the tube or passage for discharging the cleaned grain as set forth, and also for receiving and transmitting air to and through the tube, as described.

To GEORGE W. BEARDSLEE, of Buffalo, N. Y., for *Improvements in Planing Machines*. Patented May 20, 1851.—Having thus fully described my invention, I claim the yielding stock and cutter, when made to yield upon an axle, the centre of which is in line with the cutting edge of the knife. And this I claim whether the socket bolt, hinged bar and nut are or are not used, for the purpose of graduating and adjusting the cutters.

To HORACE H. DAY, of Jersey City, N. J., for *Improvement in India Rubber Shoes*. Patented May 20, 1851.—I claim the manufacture of India rubber boots and shoes, without cloth, being made of separate pieces of different degrees of elasticity, and each piece having its peculiar and requisite degree. The shoe, to possess different degrees of elasticity in different parts, and uniform elasticity in each different part, and having no part without some elasticity in every direction, by the means herein described, or any other substantially the same; whereby I lessen the cost, obtain a shoe not liable to break, which can be kept clean, stretched in every direction, at the same time easier to the foot, adjustable to large boots, and yet not rendered useless to wear over smaller, light and elegant, and retain permanently their shape.

To LAWTON J. WARE, of Warren, R. I., for *Coupling for Cords*. Patented May 20, 1851.—I claim the use of half couplings, each of similar shape and construction, formed with lips, having slots into which projecting hooks

fit, having notches serving for the bolts to enter and lock the coupling, or constructed and operating for the purposes shown, in any manner substantially the same.

To ROBERT JOBSON, near Dudley, England, for *Improvement in Reflecting Fire Places*. Dated May 20, 1851. Ante-dated Dec. 28, 1848.—I claim the extension of the curved reflector entirely around the fire-grate, in combination with having an opening through it, immediately under the first grate, for the passage of the ashes. And in combination with the first grate and the extension of the reflector under or below the grate, essentially as explained, I claim the ash guard, the same being applied in the manner and for the purpose set forth. And in combination with the reflector, and its sustaining frame, I claim the hinge slide and the sustaining rollers or their mechanical equivalent, the same being applied so as to enable the reflector to be moved outwards for the purpose of providing easy access to the chimney for convenience of removing the ashes, whenever such may be deemed necessary.

To LUTHER BOARDMAN, of East Haddam, Conn., for *Improvements in the Manufacture of Wire-strengthened Spoons, &c.* Patented May 20, 1851.—I claim the manner, substantially as herein shown and specified, of inclosing a wire of the required exact length within the handle, by supporting it on pivots secured to the moulds, and projecting midway or partly into the form.

To CHARLES W. GUILD and JOHN BROWN, of New-York, N. Y., for *Improvement in Steam Traps*. Patented May 20, 1851.—We claim the construction and application of the float, with its mouth, opening, pipe, and barrel, on the plug, with two openings for the purpose of retaining the steam in warming apparatus, or in other steam pipes, and passing out the water of condensation through the float near the bottom.

To SAMUEL PIERCE, of Troy, N. Y., for *Improvement in Hot Air Furnaces*. Patented May 20, 1851.—I claim the arrangement of the heating chambers, in connection with the furnace, when this is combined with the method substantially of connecting the heating chambers with each other with the furnace and with the exit pipe leading to the chimney, whereby the gaseous products of combustion are carried into and through, and made to spread out in thin films in the said heating chambers, and therein retained to give out heat, without seriously impeding the draught.

To LEVI BISSELL, of New-York, N. Y., for *Improvement in Carriage Springs*. Patented May 20, 1851.—I claim the constructing of springs, whether of wood or part wood and part metal, or other elastic or non-elastic substances, as adapted and applicable to carriage springs and springs for other purposes.

To ALBERT HUBBARD, Worcester, Mass., for *Improvement in Cast Iron Car Wheels*. Patented May 20, 1851.—I claim the above described improvement or wheel, made with a chilled rim, either a solid hub, or one divided cross-wise of its axis, two plates or

discs united in a serpentine curve at their outer peripheries, a third plate not only made serpentine concentrically with the hub, but curved in radial directions, all cast or founded and combined together in one piece.

To PURNELL JEFFERSON, of Bridgeton, N. J., *for Improved Gauging and Heading Movement for Spike Machines*. Patented May 20, 1851.—I claim the combination of the spring gauge and catch, constructed as described, with the dies and with the header, for the double purpose of gauging the length of the spikes or nails, and aiding in forming the heads thereon.

To ISAAC VAN KUREN, of Boston, Mass., *for Improvement in Cast Iron Car Wheels*. Patented May 20, 1851.—I claim a cast iron railroad wheel, constructed with a solid hub and a tube, the tube being united to the hub by a curved plate, with curved projecting braces on it, and connected to the tread by a curved plate, with the curved braces on it.

To HENRY RUTAN, Cohurg, Canada West, *for Improvement in Ventilating Furnace*. Patented May 20, 1851. Antedated Jan. 31, 1851.—I claim the arrangement and mode of operating the valves in reference to the air-heating space round the stove, by which the amount of air from within and without is graduated by a single movement. I claim also the arrangement of the horizontal air-heating trunk, the vertical leading thereto, and its valve, in combination with the air-heating space.

To WM. WATSON, of Chicago, Ill., and E. SABINE RENWICK, and P. HILL WATSON, of Washington, D. C., *for Improvement in Grain Harvesters and Binders*. Patented May 20, 1851.—We claim, first, the method of raking and binding grain at one operation, by the mechanism herein specified, or its equivalent. Second, we claim the arms, in combination with the levers, by means of which the rake teeth are alternately raised and depressed, as the rake is moved alternately in opposite directions, by endless rake-chains, which move continually in the same direction. Third, we claim the method of adapting the binding apparatus to the length of the cut grain by varying the respective positions of the cutting and binding apparatus, substantially as herein set forth, that is to say, by moving the front of the platform with the cutting apparatus, backward or forward, or by moving the binding apparatus nearer to or further from the front of the platform, in such a manner that the sheaf may be bound near the middle of its length, whether it be long or short. Fourth, the method of binding grain by mechanical devices herein specified, or their equivalents, acting in connection, and automatically by motion derived from or dependent upon the movement of the machine to which they are attached. Fifth, we claim the cord finger operating substantially as herein set forth, by which the grain is encircled by the binding cord. Sixth, we claim the tying forceps or the equivalent thereof, operating in connection with me-

chanism for encircling the grain with cord or band.

To BOLIVAR NEWBURY, of Catskill, N. Y., *for Improvement in Lifting Jacks*. Patented May 27, 1851.—I claim the combination in the manner herein described, of the pawls, the springs, and the spring lever, having projections on each side of its fulcrum, with the lever and the ratchets on the lifting rod, whereby the lifting rod may be forced out from or drawn into the post or standard of the jack, according to the position of the spring lever.

To HENRY BRUNK, of Albany, N. Y., *for Improvement in Lap Anvils for Shoemakers*. Patented May 27, 1851.—I claim a metal anvil, shaped as described, that is, with a form adapting it to be held conveniently upon and between the knees and thighs of a workman, having a projection above the mass of metal, conveniently formed into an anvil face, with a small prismatic block near the extremity of one of the arms, as a fulcrum for nippers, when the same are used in stretching or manipulating leather.

To JOHN ROBERTSON, of Brooklyn, N. Y., *for Improved combination of Dies for Sheet Lead Machines*. Patented May 27, 1851.—I claim the adjustable interior cylindrical and the exterior stationary conical dies, in combination and for the purposes described, irrespective of the precise manner in which they are applied or by which the adjustment is effected.

To GEORGE W. PUTNAM, of Moreau, N. Y., *for improved Vice Jaw for Saw-filing Machinery*. Patented May 27, 1851.—I claim the jaws of the vice shaped to correspond to the shape of the saw teeth, and support the same, so as to prevent vibration during the operation of filing, as herein set forth, whereby a better edge is given to the tooth, the wear of the file is diminished, and the process of sharpening expedited.

To OTIS BOYDEN, of Newark, N. J., *for Improvement in Alloys of Iron, Zinc, and Nickel*. Patented May 27, 1851.—I claim the making of wrought or malleable iron, either from ordinary iron, or from the ore, by the use or application of metallic zinc or spelter, and by the use of zinc and nickel combined as described.

To HENRY WATERMAN, of Williamsburgh, N. Y., *for Improvements in Machinery for Hardening and Straightening Saws, &c.* Patented May 27, 1851.—I claim the employment of the apparatus above set forth for straightening and hardening steel plates for saws, &c., at one operation, consisting of the fingers or cams, as described, compressed and hardened, combined with and gripped by the drop in the manner specified.

To JACOB BARNHILL, of Circleville, O., *for Improvement in Seed Planters*. Patented May 27, 1851.—I claim the conical cups attached to segmental rods extending from levers working on a horizontal shaft raised and lowered by the eccentrics and rods, substantially as described—operating in the manner and for the purposes set forth.

TO ENOCH S. FARSON, of Philadelphia, Pa., *for Improvement in Portable Swings*. Patented May 27, 1851.—I claim the suspension of a swing to the hinged frame, supported or strengthened by the adjustable brace, as set forth.

TO GEORGE B. DURKEE, of Alden, N. Y., *for Improvements in Carriages*. Patented May, 27, 1851.—I claim making the sides of the bodies or boxes of carriages of a series of springs, slats, or bars, when the same are constructed and operated as set forth.

TO W. H. HOYT, of New York, N. Y., *for Improvement in Omnibus Steps*. Patented May 27, 1851.—I claim the manner of constructing the step as described, viz. by having a portion of the body of the omnibus projecting downwards a suitable distance, the bottom of said projection forming the step, and so arranged as to be perfectly covered and protected by the door when closed.

TO JAMES C. SPENCER, of Phelps, N. Y., *for Improvements in Carriages*. Patented May 27, 1851.—I claim the manner of construction as described, viz., forming the body of two separate parts united by a joint which allows the body to vibrate and act upon a single spring, and also admits of a direct attachment of the body to the axles, as set forth.

TO EDWARD HAMILTON, of Bridgeport, Conn. (assignor to Nelson Goodyear, of New York, N. Y.), *for Improvements in excluding Dust from Railroad Cars*. Patented May 27, 1851.—I claim the application of vertical blinds, shutters, or screens on the outside of railroad cars employing the same, to prevent the entrance of dust, smoke, cinders, &c., into the windows of the cars, as described.

TO PARIS M. WALKER, of Marshall, Mo., *for Improvements in Hemp Brakes*. Patented May 27, 1851.—I claim the combining a sufficient number of slats to break the full length of the hemp at once, in combination with the manner of feeding, as set forth.

TO WILLIAM BIDDLE, of La Fayette, Ind., *for Improvement in Self-weighing Machines for Grain*. Patented May 27, 1851.—I do not claim a self-weighing machine operated by the weight of the grain, so as to form an automatic weighing machine, by which, with the aid of a register or index, the amount weighed is ascertained. Nor do I claim opening a gate or door in the bottom of a receiving hopper by the descent of a steelyard, simultaneously with the discharge of the grain from a rotating hopper. But I claim the employment of the metallic plate or its equivalent, attached to the receiving hopper, and made to rise and fall by the action of said hopper and a gauge, in such a manner that on the descent of the suspended hopper, the gauge plate connected therewith, will disengage a catch plate from the right end of the metallic plate, and permit the latter to fall, and cut off the discharge of the grain, and simultaneously therewith open a trap door in the bottom of the suspended hopper, and on the ascent of the same, the receiving hopper will be made to tilt forward by the weight of the grain, so as again to raise the plate and

open the hinged door of the said plate simultaneously with the closing of the trap-door, as fully described. I also claim the employment of the gauge plate, when combined with the lower or discharging hopper, for the purpose of determining the quantity of grain to be weighed, by limiting the descending movement of the suspended hopper, and consequently gauging the action of the projection on said gauge-plate, to cut off the discharge of the grain from the receiving hopper. I also claim the employment of the vertical pendent rods [two] confined to either side of the frame, when combined with a suspended hopper, provided with a trap door, for the purpose of opening and closing said trap door by their descent, alternately, said vertical pendent rods being respectively actuated by the descent of the metallic plate, to disengage the spring catch from the rod, to open the trap door, and by the tilting forward of the receiving hopper, to disengage the spring bar from the vertical rod, and allow its descent to close the trap door, as set forth.

TO WILLIAM A. MCFARLAN and THOMAS C. CARPENTER, of Wilmington, Del., *for Improvement in Bran Dusters*. Patented May 27, 1851.—We claim the combination of the scouring, beating, and distributing brush, with the perforated guard plate surrounding it, whereby the bran to be dressed is more equably distributed and fed to the bolt than has been done by devices heretofore in use for the purpose.

TO EDWARD MAYNARD, of Washington, *for Improvements in Breech-loading Fire-arms*. Patented May 27, 1851.—I claim, in that class of breech-loading fire-arms in which the barrel is disconnected from the breech, and is pivoted at some point intermediate between its butt and its muzzle to the stock, a lever beneath the stock, by means of which the barrel is turned upon its pivot to raise and to depress its butt, and is locked to its breech when the butt is depressed, and is unlocked therefrom to allow the butt to be raised, the several members of the implement being arranged and operating as set forth. In combination with the above claimed device, I claim a piston breech-pin, which, by the movement of the lever to depress the butt of the barrel, and to lock it in place, is made to move the cartridge forward in the barrel and to close the butt thereof, and which, by the movement of the lever to unlock and raise the barrel, is made to inclose or open the butt of the barrel before the latter rises under the action of the lever. I also claim the sliding bolt, constructed with slot and hook, or their equivalents, and arranged as herein set forth, in combination with a lever handle, for the purpose of imparting motion to the piston breech-pin from the lever beneath.

TO NATHAN DAWES and HIGGINS HARRISON, of Little York, N. J., *for Improvements in Boot Crimps*. Dated May 27, 1851. Antedated Jan. 31st, 1851.—We claim the combination of the spring frame, crimping plates,

and boot tree, with two adjustable slide springs, for the purpose of crimping boot fronts and adjusting the pressure of the crimping plates to the particular point in which the creases have a tendency to run, the whole being arranged in the manner described, or in any manner essentially the same.

Re-Issues.

To GEORGE H. CORLISS, of Providence, Rhode Island, *for Improvement in Cut-off and working the Valves of Steam Engines*. Patented March 10, 1849. Re-issued May 13, 1851.—I claim first, the method as described, of operating the slide valves of steam engines by connecting the valves that govern the ports at opposite ends of the cylinder, with separate arms of the rock-shaft, or the mechanical equivalents thereof, so that from the motion thereof the valve that keeps its port or ports closed, shall move over a less space, while its port or ports are closed, than the one that is opening or closing its port or ports, and vice versa, while at the same time the two arms, by which they are operated, have the same range of motion whereby I am enabled to save much of the power heretofore required to work the slide valves of steam engines, and by which also, I am enabled to give a greater range of motion to the valves, at the periods of opening and closing the ports, to facilitate the induction and eduction of steam. And, lastly, I claim the method of regulating the motion of steam engines, by means of the regulator, by combining the said regulator with the catches that liberate the steam valves, by means of movable cams, or stops.

To CALVIN ADAMS, of Pittsburgh, [assignor of Joseph P. Sherwood, of Sandy Hills, New York], *for Improvement in Door Locks*. Patented Dec. 17, 1842. Re-issued May 13, 1851.—I claim making the cases in which the movements of locks and latches for doors are contained, double faced, or so finished that either side may be used for the outside, in order that the same lock, or cased fastening, may answer for a right or left hand door. I also claim the peculiar construction and double action [upon an inclined and horizontal track or way] of the locking car, as described, and the combination of the locking car and two safety cars, with one another, and with the connecting or vibrating bar and bolt as described, so as to fasten the bolt securely and prevent its being picked.

To ALEX. CALDERHEAD, of Philadelphia, *for Improvement in the Jacquard Machinery for weaving all kinds of figured cloth*. Patented Feb. 3, 1841. Re-issued May 13, 1851.—I claim, first, in connection with looms for weaving figured fabrics, depressing the suspension board, or its equivalent, while the corresponding pattern card, acting as a trap-board, or its equivalent, is elevated. Second, I claim working the card prism, by mechanism connected with the loom, and whilst the boards, or their equivalents, for working the harness, are not opening and closing the shed.

Designs.

To MICAJAH C. BURLEIGH, of Somersworth, N. H., *for Design for Stove Doors and Panels*, Patented May 13, 1851.

To NATHANIEL A. BATCHELOR, City of New-York, *for Design for Clock Frame*. Patented May 13, 1851.

To JAMES HUTCHINSON, Troy, New-York, [assignor to Deborah A. E. and Nathaniel Powers, of Lansingburgh, N. Y.], *for Design for Floor Oil Cloth*. Patented May 23, 1851.

To JAMES WAGNER, DAVID PRATT, and VOLNEY RICHMOND, Troy, N. Y., *for Design for Stoves*. Patented May 23, 1851.

To PELETIAH M. HUTTON, of Troy, N. Y., *for Design for Bedsteads*. Patented May 20, 1851.

To WILLIAM L. HATHAWAY, of Dighton, Mass., *for Design for Stoves*. Patented May 27, 1851.

To N. P. RICHARDSON, of Portland, Me., *for Design for Stoves*. Patented May 27, 1851.

To EZRA RIPLEY, of Troy, N. Y., [assignor to Stafford & Co., of Troy, *for Design for Stoves*. Patented May 27, 1851.

List of English Patents issued from April 24, 1851, to May 14, 1851.

Daniel Dalton, of Span-lane, West Bromwich, Stafford, for improvements applicable to railroads. April 26; six months.

J. C. Haddan, of Bloomsbury-square, civil engineer, for improvements in the permanent way of railways, in railway and other carriages, and in the manufacture of papier mache to be used in making carriages and other articles. April 26; six months.

James Bagster Lyall, of Thurlow-square, Brompton, Middlesex, gent., for an improved construction of public carriage. April 26; six months.

Benjamin Hyam, of Manchester, tailor and clothier, for certain improvements in the method of fastening down trousers, or other articles of wearing-apparel. April 26; six months.

Jonathan Wragg, of Wednesbury, Stafford, coach and axle-tree smith, for certain improvements in railway and other carriages. April 26; six months.

Robert Milligan, of Harden Mills, near Bingley, York, manufacturer, for a new mode of ornamenting certain cloth fabrics. April 26; six months.

James Nasmyth, of Patricroft, Lancaster, engineer, and Herbert Minton, of Stoke-upon-Trent, Stafford, china manufacturer, for certain improvements in machinery or apparatus to be employed in the manufacture of tiles, bricks, and other articles, from disintegrated or pulverized clay. April 26; six months.

Benjamin William Goode, of Birmingham, Richard Boland, of the same place, and James Newman, also of Birmingham, for improvements in chains, chain-pins, swivels, brooches, and other fastenings for wearing-apparel. April 29; six months.

Henry Lund, esq., of the Temple, for improvements in propelling. April 29; six months.

Philip Webley, of Birmingham, manufacturer, for improvements in the manufacture of boots and shoes, and in rendering the said manufacture waterproof, also in the machinery and materials to be used therein. April 29; six months.

William Edward Newton, of Chancery-lane, civil engineer, for improvements in the manufacture of woven and felted fabrics. (Being a communication.) May 3; six months.

John James Greenough, esq., of Washington, United States of America, for improvements in obtaining and applying motive power. (Being a communication.) May 3; six months.

Gaetan Kossovitch, gent., of Middleton-square, Middlesex, for improvements in rotary-steam engines. (Being a communication.) May 3; six months.

Edwin Rose, of Manchester, Lancaster, civil engineer, for certain improvements in boilers for generating steam. May 3; six months.

Charles Cowper, of Southampton-buildings, Chancery-lane, for improvements in coverings for buildings. (Being a communication.) May 3; six months.

Peter Armand Lecomte de Fontainemoreau, of South-street, Finsbury, Middlesex, and 24 Boulevard Poissonniere, Paris, France, for improvements in the manufacture of fuel. (Being a communication.) May 3; six months.

William Smith, of Upper Grove-cottages, Holloway, Middlesex, engineer, for improvements in locomotive and other engines, and in carriages used on railways. May 3; six months.

Pierre Armand Lecomte de Fontainemoreau, of South-street, Finsbury, London, and 24 Boulevard Poissonniere, Paris, for certain improvements in electric telegraphs. (Being a communication.) May 3; six months.

William Cooke, of 18 Gt. George-street, Westminster, Middlesex, civil engineer, for improvements in the manufacture of soda and the carbonate thereof. (Being a communication.) May 3; six months.

James Pyke, of Westbourne-grove, Bayswater, Middlesex, for improvements in the manufacture of leather; also in the making of boots and shoes. May 3; six months.

Alexis Delemer, of Radcliffe, Lancaster, civil engineer and machinist, for certain improvements in the application of coloring matter to linens, cottons, silks, woollens, and other fabrics, and to linen, cotton, silk, woollen, and other wett, and also in machinery or apparatus for these purposes. May 6; six months.

William Henry Brown, of Ward's-end Steel Works, near Sheffield, York, steel-roller, for certain improvements in the manufacture of helves. May 6; six months.

Thomas Robert Mellish, of Regent-street, Middlesex, glass manufacturer, for certain improvements in instruments and apparatuses for the admission and exclusion of light and air into and from buildings and carriages, and in the manufacture of reflectors of light; parts of which improvements are also applicable to the decoration of articles of furniture. May 7; six months.

William Edward Newton, of 66 Chancery-lane, Middlesex, civil engineer, for improvements in apparatus for the generation and condensation of steam for various useful purposes; also improvements in certain parts of engines to be worked by steam, air, or gases. (Being a communication.) May 8; six months.

Harding Hallen, of Burslem, Stafford, manufacturer, for improvements in gas burners. May 10; six months.

Charles Morey, gent., United States, America, for improvements in machinery for preparing, dressing, cutting, and shaping stone, and other materials made use of for building purposes and architectural decorations. May 10; six months.

Emilian de Dunin, gent., of Queen Charlotte-row, Newroad, for improvements in apparatus for measuring persons, and for facilitating the fitting of garments. May 4; six months.

Thomas Haines and John Webster Hancock, of Melbourne, Derby, manufacturers, Albert Thornton, of the same place, and James Thornton, of Leicester, mechanics, for improvements in the manufacture of knit and knitted looped fabrics, and for raising pile thereon. May 10; six months.

Edward Wilkins, gent., of 60 Queen's-row, Walworth, Surrey, for improvements in labels or tickets. May 13; six months.

Edward John Carpenter, esq., of Toft Manks, Norfolk, captain in Her Majesty's navy, for improvements in the construction of ships and vessels, and in machinery or apparatus for propelling and directing the same. May 13; six months.

Luke Smith, of Littleborough, Lancaster, mechanic, Mark Smith, of the Sun Ironworks, Heywood, in the same county, power-loom maker, and Matthew Smith, of Over Darwen, in the same county, for improvements in fabrics, in weaving, and in machinery and apparatus for winding, weaving, cutting, and printing. May 14; six months.

William Hensley, of Melbourne, Derby, lace manufacturer, for improvements in the manufacture of looped fabrics. May 15; six months.

Robert Oxland and John Oxland, both of Plymouth, chemists, for improvements in the manufacture and refining of sugar. May 15; six months.

William Longmaid, gent., of Beaumont-square, for improvements in treating ores and minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali. May 10; six months.

Hugh Barclay, of Regent-street, Middlesex, for improvements in the means of extracting or separating fatty and oily matters, in refining and bleaching fatty matters and oils, animal and vegetable, wax and resins, and in the manufacture of candles and soap. May 19; six months.

Perceval Moses Parsons, of Robert-street, Adelphi, civil engineer, for improvements in cranes capable of being used on railways, and in parts of railways. May 19; six months.

George Tate, gent., of Bawtry, York, for improvements in the construction of dwelling-houses and other buildings, including floating vessels, and for the adaptation and manufacture of materials for such uses. May 22; six months.

Benjamin Bailey, of Leicester, for improvements in the manufacture of looped fabrics. May 23; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improvements in the carbonization of coal, and in the utilization of the products disengaged during that operation, in improving the quality of the products intended for illuminating purposes, and in regulating of the same. (Being a communication.) May 27; six months.

Archibald Slate, of Woodside Ironworks, Worcester, for improvements in steam engines and steam boilers, and in the passages and valves for the induction, education, and working of fluids. May 27; six months.

John Fielding Empson, of Birmingham, for improvements in the manufacture of buttons. May 27; six months.

John Harrison, of Blackburn, Lancaster, for certain improvements in the manufacture of textile fabrics, and in the preparation of yarns or threads for weaving. May 27; six months.

A grant of an extension unto James Potter, of Manchester, Lancaster, cotton spinner, for the term of five years, from the 21st December, 1850, for his invention of certain improvements in spinning machinery.

William Crane Wilkins, of Long-acre, Middlesex, engineer, for certain improvements in railway buffers. May 29; six months.

Joseph Reynolds, of Vere-street, Middlesex, card maker, for improvements in the manufacture of cards usually denominated playing cards. May 29; six months.

John Pegg, of Leicester, manufacturer, for improvements in producing corrugated surfaces and leather. May 29; six months.

Henry W. Adams, of Boston, Suffolk, Massachusetts, United States of America, for an improved means of generating galvanic electricity, of decomposing water or various electrolytes, of collecting hydrogen, of burning it, or atmospheric air, separately or in combination. May 29; six months.

Robert William Sievier, of Upper Holloway, Middlesex, civil engineer, for improvements in weaving and printing textile fabrics. May 29; six months.

John Ashworth, of Bristol, manager of the Great Western Cotton Works, for certain improvements in the method of preventing and removing incrustation in steam boilers and steam generators. May 29; six months.

NOTICES AND CORRESPONDENCE.

The Legislature of the State of New York, it is known, at their last session, chartered a new University, to be located at Albany, and to be called "The University of Albany." An Institution of the character this is designed to be, is, we conceive, well located at the seat of government. Aside from other more weighty considerations, we cannot but regard any movement which tends to bring the members of our Legislatures into contact with men of learning and education, as a measure fraught with good to all.

However sound, substantial, and clear-headed our individual Legislators may be, (and we concede them all this,) it must be admitted that they do not, as a body, claim to be learned, nor, as we are aware of, "lovers of learning;" but they are, nevertheless, the very men to avail themselves of the opportunity for improvement afforded by the method of instruction pursued at Universities, viz, lectures open to all. And we conceive that a University located at the seat of government may, through this, find means to extend her influence into the remotest corners of the State. And it may well be credited, that the presence at our seat of government of such men as Agassiz, Hall, Gould, Norton and Mitchell, can be viewed in no other light than as a chief means for the diffusion of knowledge throughout the length and breadth of the land.

In this eminently practical age, we may hope to see included in the instructions of this University the science of Building; including both the mechanic arts upon which it rests, and the principles of design—too frequently lost sight of as a branch of construction.

If a painter, after years of study, produces (as frequently happens) a wretched picture, the evil is not likely to be perpetuated, for the simple reason that it is soon out of sight: but the Architect, with infinitely less study, is intrusted with the preparation of a design which, built of imperishable materials, and in broad daylight, is to be gazed upon by thousands of thousands—affecting the taste of the unlearned and the learner, and perpetuating sterility and poverty of design, it may be, to the end of time.)

A school of Architecture, in which the "rule and compass" are treated less as guides than as tools, is much needed; and we trust so good an opportunity will not be suffered to pass without at least an effort being made to supply a crying want.

The rumor has reached us that the strength of the new Suspension Bridge, over the Niagara, just completed, will prove totally inadequate to the duty it is called upon to perform. The rumor is from a source entitled, in our opinion, to the highest credit; and in another number we will lay the subject before our readers.

To the Editor of *Appleton's Mechanics' Magazine and Engineer's Journal*:

SIR—Will you be kind enough to let me know how it is that (in an article in your sixth number,

page 367, entitled *The new Sounding Machine of M. Faye*,) the pressure at a depth of ten miles of the ocean is stated to be considerably over three tons, or forty-five atmospheres? I am given to understand, from works on mechanics, that the mode of calculating water pressure is, *that the pressure of a fluid on any surface is equal to the weight of a column of the fluid whose base is equal to the surface pressed, and whose height is equal to the distance of the centre of gravity of that surface below the horizontal surface of the fluid.*

Now the weight of such a column 10 miles deep and standing on 1 square inch of surface, is equal in weight to about ten tons, instead of three tons, as stated in the article above mentioned. Another thing is, that 45 atmospheres don't equal three tons, but 450 atmospheres do nearly.

A SUBSCRIBER, Quebec.

P. S. I would also like to know (in No. 4 of the Magazine, page 228, article *Mechanics for the Million*,) which is the example S alluded to in example 7, or where example 8 alluded to is to be found.

S. Q.

In answer to the above queries, all we can say is; that our correspondent is entirely correct in his estimate of the pressure of water. The actual pressure of water at great depths not affecting the principle of Faye's sounding machine, led to our copying the article as we found it in a foreign journal, without looking to the calculations—they being of a character too simple to admit of any doubt in their accuracy.

To the second query, we answer that in making up a magazine of fixed dimensions; some articles are required to have an India-rubber organization; admitting of expansion or contraction, as the necessities of the case may require. The character of this article admits of its use as a constant closer. In the performance of its duties it seems unfortunately to have lost a member—a result not much to be wondered at; on the contrary, that it does not happen more frequently is a source to us of peculiar gratification.

If we mistake not, we are indebted to this subscriber for a well-written article on the subject of a bridge across the river St. Lawrence.

Not wishing to mutilate the article, and not having space for the whole of it in this number, we are under the necessity of postponing its publication. The project exhibits great boldness and ingenuity, and is worthy of consideration in some of its features. In the mean time, our impression is that no vital interests will suffer by this delay in its publication. Before a bridge be built over the St. Lawrence, one mile in length and in water of the depth of 180 feet, the public will have an opportunity of hearing something of it—possibly of contributing to its erection.

Preservation of Oak.—To season it:—The nearer the timber approaches the dimensions required from the saw the more likely is it to get seasoned. It should be placed on the north side of a building, and sheltered from the extremities of the wind and rain. Place one piece upon another, interposing blocks between them; and that the timber may not cleave, but dry equally, daub it over with cow dung. Thus it must remain at least twelve months. After this saw it to the size required; then lay it in a tank or pool of water for several hours; from thence into a

copper of boiling water, continuing boiling for one or more hours, according to the size of the timber (steaming the wood no doubt would be nearly as good); afterwards it should be placed upright to drain on the north side of a building, exposed to the wind and rain, and gradually, within three or four months, to the sun, when it may be used for its respective work.—*London Builder*.

Think of our builders waiting sixteen months for the timber to season! Why, the buildings themselves are not expected to last much longer—certainly not without repairs.

Extinction of Subterranean Fire by Steam-Jet.—Mr. Goldsworthy Gurney has extinguished a sort of volcano, which has raged without ceasing for 30 years, over an area of 26 acres of coal-seam under ground! This new triumph of scientific principle has been achieved in Scotland, at the South Sauchie colliery, near Alloa. The seam of coal in course of destruction by the fire is 9 feet thick. It was set fire to, it is believed, by illicit distillers. A puddle-wall, to arrest its ravages, was erected at great hazard, at an expense of 16,000*l.*, about 19 years ago, after 5 years' labor of many hands, and at a sacrifice of 12 lives. The upholding of this wall, moreover, has ever since cost the Earl of Mansfield, who is the owner, 200*l.* a year. Various reports, made by men of great authority in the coal trade, agreed in the belief of the utter impossibility of extinguishing this fire. The object has been accomplished, as many of our readers will be already well aware, by forcing into the burning waste a kind of choke-damp formed of nitrogen and carbonic acid, the product of a coke furnace, kept burning three weeks for the purpose, and pouring the choke damp along an iron cylinder down the shaft and into the burning waste; the quantity of coke consumed being a sufficiently accurate measure of the quantity of air passed. To cool down all the material, so as to prevent its again igniting on the admission of atmospheric air, Mr. Gurney justly considered the most uncertain part of the whole experiment. In order to effect this, he used a fine contrivance, by which, by the power of the steam-jet, water was driven into the shaft along with the choke-damp. In the form of the finest spray: it is described to have been like a continual Scotch mist. After a month's operation the temperature of the waste was reduced from 250 to 98. Several bore-holes have been driven into the waste at different points, but no fire can be discovered; and this great volcano is extinct! Mr. Cayley, of Westminster, who took some part in the experiment, has published an account of the process.

Stait's Electric Light.—Public curiosity has been much excited to be made acquainted with the report of a committee who were appointed, so far back as August, to inquire into the adaptation of this light for general illumination. The committee having terminated their labors, the 9th inst. was the first time the exhibition took place of the apparatus, constructed with a view of testing the self-sustaining power of the mechanical arrangement adopted for the continual development of the light, the sustaining power of the battery and the cost of the whole. At four the light was set in action, it being understood that it was to burn for five hours and a quarter without interruption, that being the period at which the committee had expressed themselves satisfied that it could be continued for any definite length of time. From four o'clock to six the light continued to burn with increasing brilliancy, giving successively a light, adjudged equal, the first half hour, to 200 candles, at five to three, at half-past five to 400, and so successively till the electric fluid came into its fullest action at half-past six, when the light, by the instrument used, developed the immense number of 700 candles, which intensity of light was steadily kept up till the experiment concluded at a quarter past nine o'clock. Colored prints were brought from the influence of the direct sunbeam to that of

the ray from the electric light, in which not the slightest difference of shade of color could be observed. The light of each was then passed through the prism, which still further established their identity, as their point of junction could not be ascertained, thus proving its immense value to the manufacturer and exhibitor of goods. Before the company separated, a portion of the solutions produced by the action of the battery were drawn off and precipitated, and a white powder produced, which was represented to be of a commercial value sufficient to pay the whole expense of producing the light.—*Condensed from the Manchester Courier*.

Substitute for Marine Glue.—A transparent substance, well adapted to replace the marine glue of Jeffreys for many purposes, particularly where a transparent joint is required, as in the union of pieces of glass, has been invented by Mr. S. Lender, of Philadelphia. The composition is as follows:—caoutchouc 15 grains, chloroform 2 ounces, mastic half an ounce. The two first-named ingredients are to be first mixed: after the gum is dissolved the mastic is added, and the whole allowed to macerate for a week. More caoutchouc may be added where great elasticity is desirable. The convenience of its application with a brush, and, recommends it for approval.—*Franklin Journal*.

BERLIN.—Electro-magnetic Clocks.—This discovery has been patented by M. Siemens, lieutenant of engineers, who has associated himself with the astronomical watchmaker M. Tiede for that purpose. As there exist already at Berlin electro-telegraphic wires for signaling fires, the same apparatus will also be used for the clocks. There will be established several leading clocks in the different parts of the town, which, being connected with the wires, will indicate the time on *simple dials*. The cost of such a clock and wires will be twenty-eight thalers, the subsequent yearly expense only four thalers. Such apparatus can be applied at any private house, and an additional advantage would be, that all these watches would keep an uniform and exact time.

THE SAFE FOR THE KOH-I-NOOR, (the mountain of light,) contrived by Mr. Chubb, consists, first, of an octagon table 6 ft. 6 in. in diameter by 3 ft. 4 in. high, the top and sides being made of $\frac{1}{2}$ in. wrought-iron plates, all secured together by being rebated and with angle iron. In the interior is a fire-proof safe 12 in. square, and 2 ft. 9 in. deep, the wrought plates being 1 in. thick. In the centre of the safe is a platform 9 in. square, on which the velvet cushion, jewels, and setting are fixed. A hole is cut out of the table to allow the platform to descend into the safe. In order to secure the diamonds at night, a small door 3 in. square, in one of the panels of the table, is unlocked, and by turning a winch the platform gradually sinks into the safe, and a sliding iron door is drawn over the opening at the top.

The cage is secured to the table by γ pieces at the bottom ring dropping into corresponding holes, and these are locked by two separate detective locks: the keys of these locks are held by the crown officers, and without them access to the jewels cannot be had. The key of the small door allows the platform to be raised or lowered only, but does not give access to the jewels. The weight of the whole is 36 cwt., and it is bolted to the floor.

IMPROMPTU LINES,

BY AN AMERICAN,

On the space appropriated to America in the Exhibition, but now occupied as a resting place for the weary.

Diamonds, nor Pearls, nor works in Gold are here;
To other climes the palm in these be given;
We freely offer what we hold most dear—
A resting place for all men under heaven.

N. Y. Evening Post.

VAUGHN'S RAILROAD CAR-WHEELS.

Fig. 7.

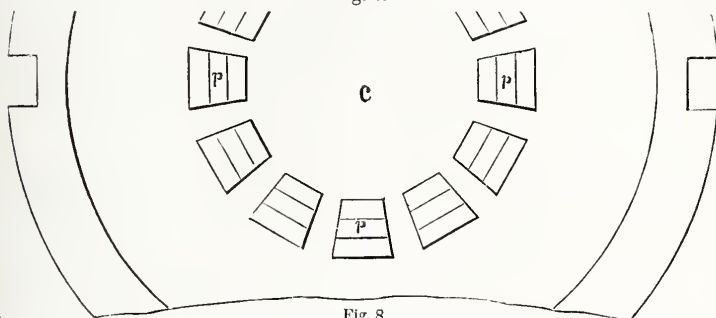
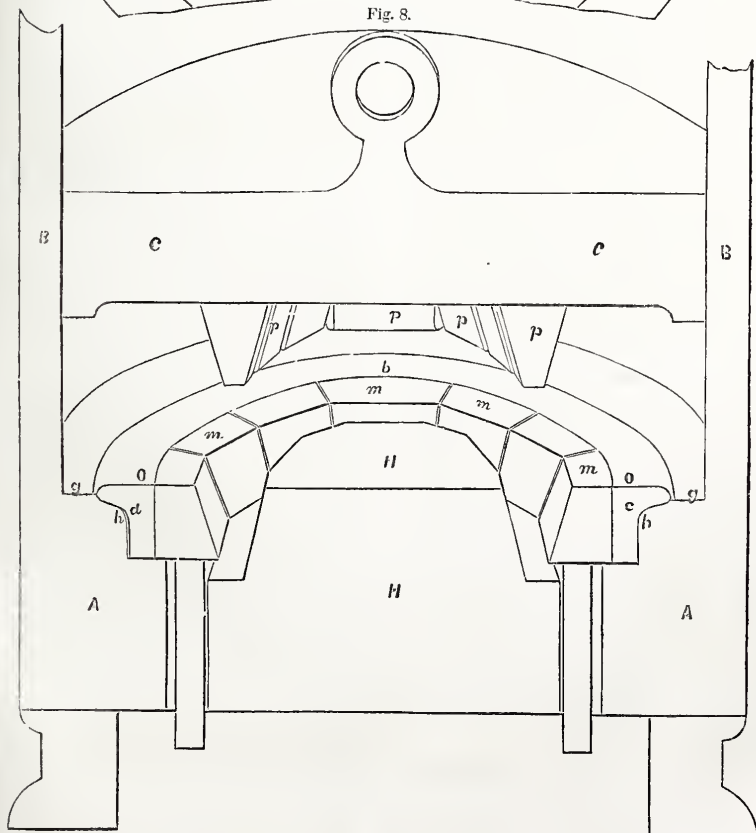


Fig. 8.



VAUGHN'S PROCESS FOR MAKING RAILROAD CAR WHEELS OF WROUGHT IRON.

From the Specification of the Inventor, J. C. Vaughn, of Greenbush, New-York,

THE iron used in the construction of the wheel is of various forms and sizes, and such as can be prepared by the ordinary process of making bar-iron.

It is so prepared, and then cut from the bar into the lengths required for the sizes of the various members of wheels.

To form the *hub*, the material is from iron rolled into prismatic bars, whose cross section is isosecles triangular, (thus Δ , or the same truncated Δ), as shown at *c c* in the various drawings, these prisms being proportioned to the size of the hub, and the size and number of spokes to be inserted therein. The bars being cut into pieces of the length of the hub, are placed in the positions shown in figs. 1 and 2, *c c c*, round a *temporary axle*. To form the *tire* of the wheel *x x*, figs. 3, 4, 5, a flat bar of iron, of proper width and thickness, is bent round in a circle of the required circumference, and has its ends welded smoothly together. This being placed concentric with the *hub*, the *spokes* are cut from flat bar iron of the width and thickness required, and of the proper length, so that, when inserted between the prismatic pieces of the *hub*, and bent to lie just inside of the *tire*, they may reach, as shown at figs. 3 and 5, from the eye of the hub to the *tire*, with their bent arms nearly from one spoke to the next one; or, if it be not necessary to make the bent arm reach from spoke to spoke, then so far as to make a good and sufficient welding surface between the *tire* and spokes. The spokes are now to be secured to the *tire* by a small rivet *z*, or in any other convenient way, and the parts forming the *hub* also secured by the hoops or rings *m m*, and then the wheel is ready for the welding process, the small oblong spaces left under the rings *m m*, and between the Δ shaped bars, being first filled up with corresponding pieces of iron.

The machinery in and by which the process of welding is to be performed is represented by figs. 4 and 5 and 6.

Fig. 4, A A, represents a vertical section through the centre of a cylindrical metal box, whose internal diameter is a very little larger than that of the wheel just described.

The bottom of this box is formed into

a *die* or *mould*, (as the profile of its section shows,) to correspond with the intended shape of one side of the finished wheel. On the bottom are placed *iron blocks*, represented in profile at *g h*, fig. 4, and in plan, fig. 5. These are shaped and fitted to lie between the spokes of the *wheel* described, and nearly fill up the spaces between the *hub*, *tire* and *spokes*, as will be seen in the plan, fig. 5, where the wheel is shown lying on the bottom of the box or matrix, and the *blocks* or *welders*, *g h*, lying in their places.

Each of the blocks has an oblong narrow fin *i j*, from its bottom, extending below the outside bottom of the *box*, through a narrow radial slot—the object of this being not only to guide the blocks when operating, but, by means of their projecting fins, to move them whenever it should become necessary.

Each pair of these blocks, excepting when in operation, are kept close to each other by springs of any kind attached to the *fins* below the bottom of the box, and set to press toward each other.

Through the centre of the bottom of the box or mould, there is a circular hole for the passage of a *mandrel m*, which is of the diameter required for the eye or bore of the *hub*.

This mandrel may, if required, be attached to the hammer or ram, to be described, yet loosely, so as to detach itself after the blow of the machine.

Over the mould, a heavy *hammer* or *ram B B*, figs. 4 and 6, traverses up and down, guided and kept from turning by slides *c c*. The lower face of this ram is formed into a die, corresponding with the intended shape of the side of the wheel, not formed by the bottom of the mould, as shown by its section fig. 4.

On the lower face, there are fixed directly over the points where the blocks *g h* touch each other, wedges *R R*, shown in plan at fig. 6, and in profile at fig. 4.

The edges of the blocks *g h* are sloped or bevelled, each at the angle corresponding to the side of the wedge that faces towards it, so that, when the ram is lowered, and the wedges entered between the blocks, they shall be forced outward from each other with a steady horizontal movement. If it be deemed expedient,

Fig. 6.

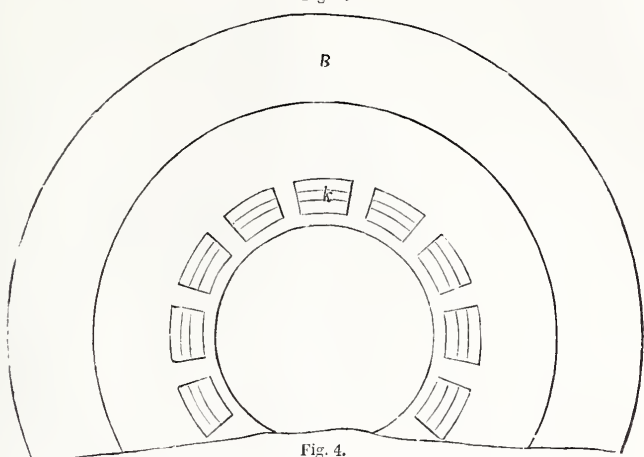


Fig. 4.

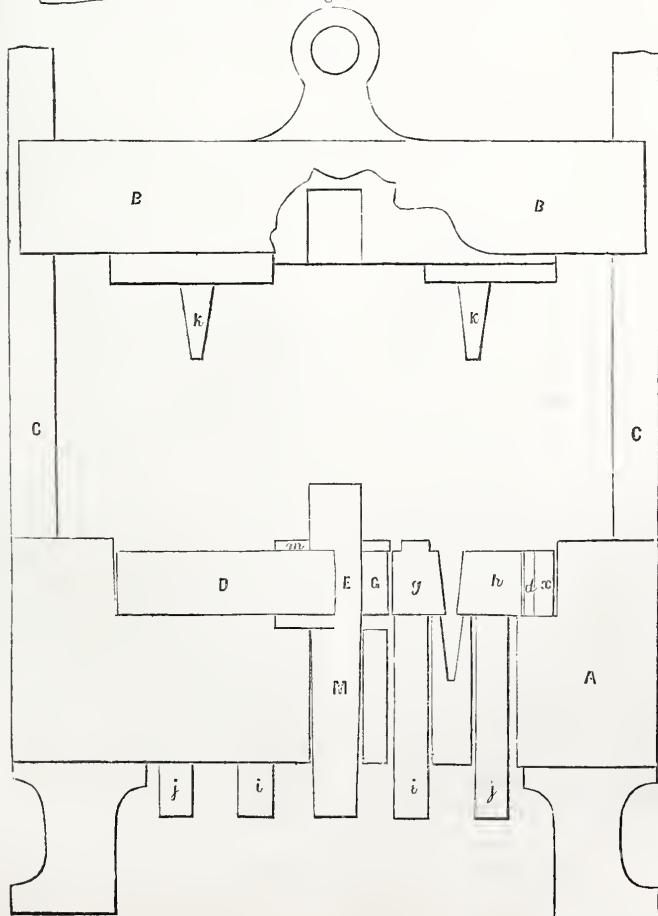


Fig. 1. Profile of Hub with spokes.

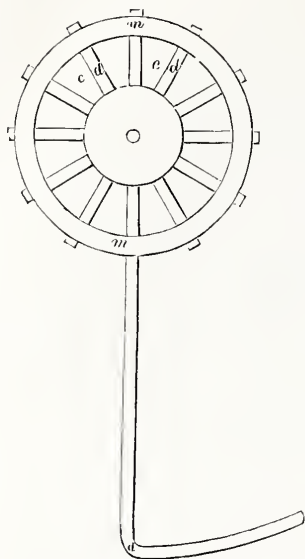


Fig. 3.

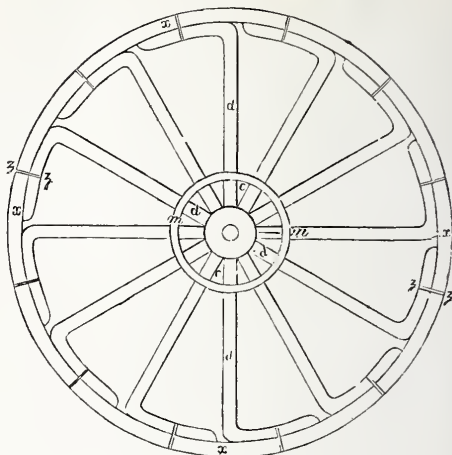


Fig. 5.

Fig. 2. Front view Hub without spokes.

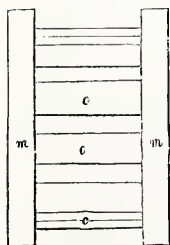
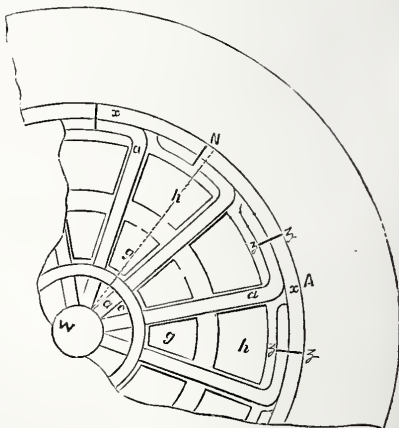
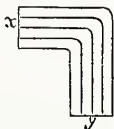


Fig. 9.



instead of using the single ram, with the wedges attached, it may be divided into two parts, a lower section as just described with the wedges attached, and an upper section, simply a weight or ram by which several blows can be struck upon the lower section, without removing that lower section with its wedges. The process of making the wheel is as follows: The various parts being secured together as above described, the whole fabric is subjected to a welding heat in a suitable furnace, and, when heated sufficiently, is laid quickly into the bottom of the mould A A, as shown in the fig. where D E G a x

represents the wheel, the part from D to E showing the face of the tire, and the part G a x being a section through the wheel at w x, as shown in fig. 5. The instant that the wheel is in its bed in the mould, the ram is brought down with great power, forcing the wedges between the welding-blocks, and pressing them apart, the blocks g g pressing the component parts of the hub against the mandrel, and the blocks h h pressing the curved arms of the spokes with the tire against the inner wall of the mould A A. At the same time, the blow of the ram compresses or upsets the edges of the

tire, spokes, and hub, between its face and the bottom of the mould, the joint operation of which pressures results in the compressing and welding of the separate parts of the wheel firmly together, and giving it a proper form. This makes a wrought iron wheel for ordinary use, but, for a railroad ear wheel, it is necessary to add the outer or flanged tie—for which the wheel is now ready.

IMPROVED KNITTING MACHINE.

From the Specification of the Inventor, J. R. Ellis, of Boston, Mass., patented June 17th, 1851.

Fig. 1,* denotes a front elevation of the said improved knitting machine. Fig. 2, is a vertical and transverse section of it, the same being taken in such manner as to exhibit the yarn guide or director, the stitch hook and the contrivance for forcing the work down towards the roots of the needles, after the formation of each new loop. Such other figures as may be necessary to a proper representation of the various parts of my improvements, will be hereafter referred to, and described.

The machine as improved, is not what is usually termed a stocking loom, but is more properly named a knitting machine, for the reason it forms each stitch of the work in regular succession and not a number of stitches at once as does the stocking loom. It is a machine in character like others in use, although it differs from the same in sundry important particulars which constitute my invention, and which I shall hereafter describe.

In the drawings above mentioned, A denotes the endless chain belt of knitting-needles, which is so made, that the needles *a a a*, &c., instead of being arranged or made to stand horizontally and at right angles to the vertical surface of the belt, are made to stand vertically or in the plane of the belt, as seen at *a a a*, figures 1 and 2.

The driving pinion *b*, instead of being arranged within the belt as it has been in other machines of this character, is disposed on the exterior surface of it, and works against, or with the projecting points of the belt. That part of the inner surface of the belt, which is immediately adjacent to the pinion, is supported by, and works round a stationary

vertical post or guide *c*, (see fig. 3, which is a vertical section of the belt and its support) that extends upwards from a horizontal arm, *d*, which projects from the main frame B. The opposite end of the endless belt is supported by a straining contrivance, L, which is similar to such as are in common use in such machines. The work or knitting hands within is the endless belt, instead of without it, or on the outside of it.

The yarn guide or director, is seen at D. It consists of a curved arm, made to extend from a horizontal rocker shaft *f*, and to have a small conical and split tube *g*, on its outer end, through which tube the yarn is carried from the bobbin placed in any convenient position.

The stitch hook is seen at E. It is arranged in rear of the chain belt of needles, and is formed as represented in side view, on an enlarged scale, fig. 4, that is to say, it is made not only with a hooked end, as seen at *h*, but with a shoulder, *i*, a short distance in rear of said hooked end, the shoulder performing the important office of piercing or easing the loop (taken up by the hook) over the hooked point of the needle, the same having been effected in other machines of this kind, by what is usually termed the "bent finger." By my improvement I am enabled to dispense with such bent finger, and the machinery for operating it. In order that the stitch hook may not only take up the loop, but cast it over the end of the needle and the yarn laid on the needle by the yarn director, and this to form or make a new stitch, the hook should have the following movements imparted to it. First, it should be made to pass unto the groove of the needle, and under the stitch on the needle. Next, it should be made to rise upwards so as to carry the stitch up to the hooked end of the needle. Next, it should be moved laterally far enough to be opposite the space between the needle (first operated upon) and the next needle. Next, it should be moved forwards between the two needles and so as to cause the shoulder *i*, to press or force or cast the stitch over the hooked end of the needle. The stitch hook should next be drawn backwards and depressed so as to disengage it from the stitch. The movements of the stitch hook may be produced by various kinds or combinations of me-

* The letters in the cut are by mistake made capital instead of small letters.

Fig. 1.

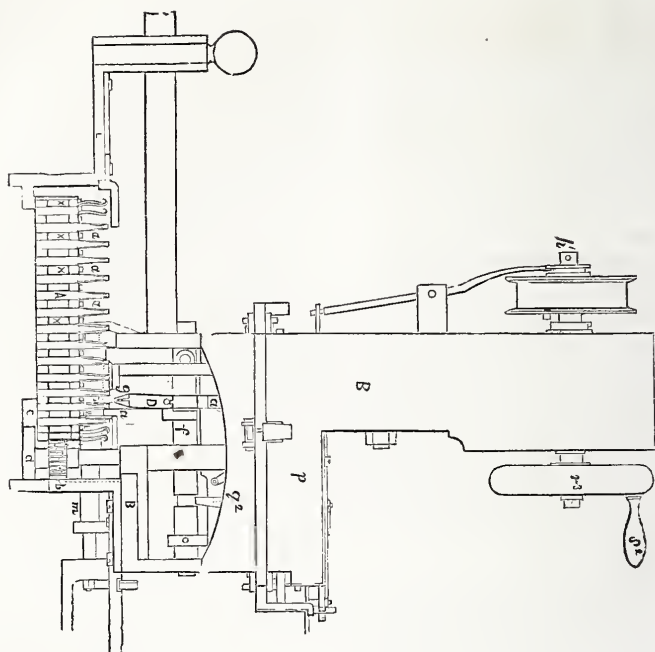


Fig. 9.

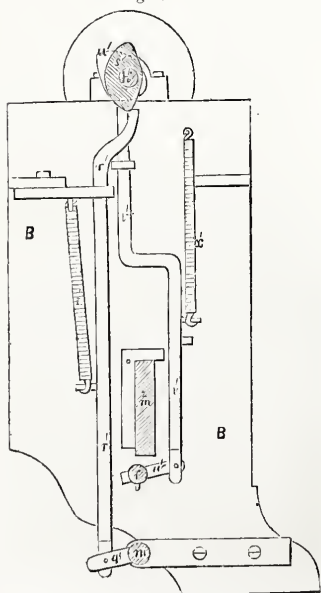


Fig. 6.



Fig. 7.

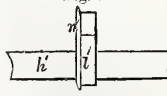
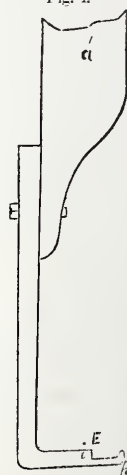


Fig. 4.



chanism. No such machinery forms any part of my invention, and I lay claim to none in particular, but employ such as may be suitable: that adopted by me is as follows, viz:

The stitch hook, *E*, is fastened to the lower end of a bar, *a'*, which works or slides freely up and down through a piece of metal, *b'*, and is jointed by a joint screw, *c'*, to a connecting rod *d'*, on whose upper end is a strap, *f'*, passing around an eccentric, *g'*, fixed on the main driving shaft, *h'*, of the machine. The upward and downward movements of the stitch hook are effected by such eccentric during its entire revolution. In order to produce its forward and back movements, a lever, *i'*, working on a fulcrum, *k'*, is jointed at its lower end to the rear end of the piece of metal, *b'*. The upper end or arm of the said lever, rests against a cam, *l'*, fixed on the driving shaft, (see fig. 5,) which denotes a top view of the said shaft, and the cams applied to it. See also figures 6 and 7, the former of which is a side view of the said cam and the wing cam to be hereinafter described, while the latter is a top view of the same, made so as to show the form of the wing cam. During the revolution of the cam, *l'*, the lever, *i'*, will be moved forward and backwards by the action of the said cam and a spring, *m'*, made to bear against the rear side of the said lever. The small wing cam, *n'*, placed on the side of, or to project above the cam, *l'*, serves to press the upper end of the lever, *i'*, laterally, in order to produce the lateral motion of the stitch hook. A spring, *o'*, see fig. 5, presses the end of the lever, *i'*, against such wing cam.

Both the stitch hook, and the yarn guide, are arranged between the arms of the presser, which presser consists of two arms, *k*, *l*, extended at right angles from a horizontal rocker shaft, *m*, and long enough to play between the needles. These arms should be made to operate so as to press the work down to the roots of the needles, after the formation of each stitch; they should next be raised upwards far enough to allow of the movement of the chain belt, which having taken place, they should be depressed so as to hold the work down until the stitch hook has fairly hooked under or taken up the stitch on the needle, against which it may be acting.

The presser should next be elevated with the stitch hook, so as to allow the work to rise. While the stitch hook is easting the stitch or loop over the hook of the needle, the presser should be stationary, but as soon as this has been effected, and the hook has withdrawn itself from the stitch, the presser should be depressed so as to force the work down to the roots of the needles. Such movements may be attained by any suitable machinery applied to the rocker shaft of the presser, such mechanism constituting no part of my invention;—but that which I employ may be thus described:—Fig. 8 is a front elevation of the machine as it appears when its front plate *p'* and the endless chain *A* are removed from the remainder of the mechanism. Fig. 9 is a vertical cross section of the machine; the same being taken looking towards the left through the cam, which operates the presser.

From the shaft *m* of the presser, an arm *q'* extends towards the front, and is jointed at its outer end to an upright and bent bar *r'*, whose upper end is forced upwards against the cam *s'* by means of a spring *t'*, one end of which is attached to the bar *r'*, and the other to the frame or box *B* as seen in fig. 8 and 9. The cam *s'* is fixed on the driving shaft, and during its revolution, it, in conjunction with the spring *t'*, produces the rocker motions of the shaft *m*, such as will cause the presser to operate in the manner required.

Directly after each movement of the chain belt, the yarn guide or director *D* should be moved forward beyond the back needles, so as to lay the yarn on that needle on which the new stitch is to be made. After the stitch has been formed, the yarn guide should be retrograded and carried back of the needles, in order that the chain belt may perform its next movement without obstruction. The mechanism for operating the yarn-guide or director *D* consists of a cam *u'*, fixed on the driving shaft, a slide rod or bar *v'* (whose lower end is jointed or hinged to the outer end of an arm *w'*, extended from the shaft *f*;) and a spring *x'*, which forces the bar *v'* up against the cam—the said cam being shown in fig. 9, by dotted lines.

The machinery for moving the chain belt forms no part of my invention, ex-

Fig. 8.

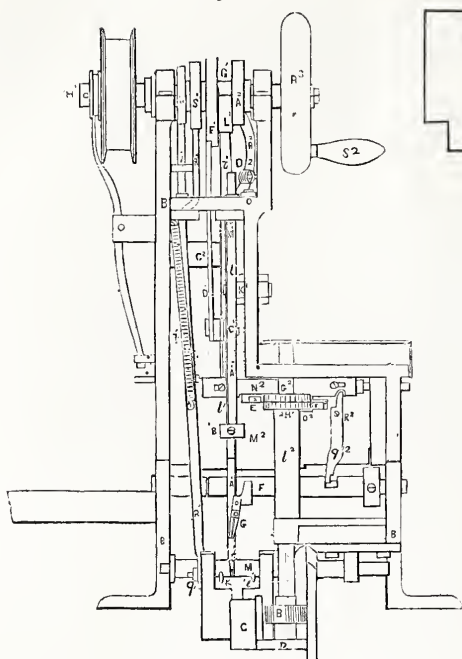


Fig. 12.

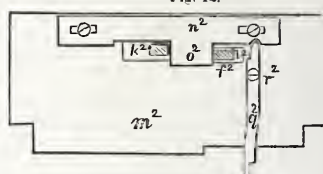


Fig. 3.

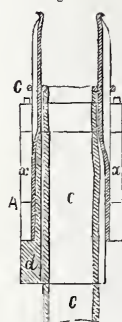


Fig. 5.

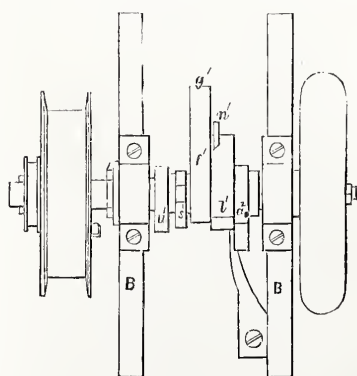
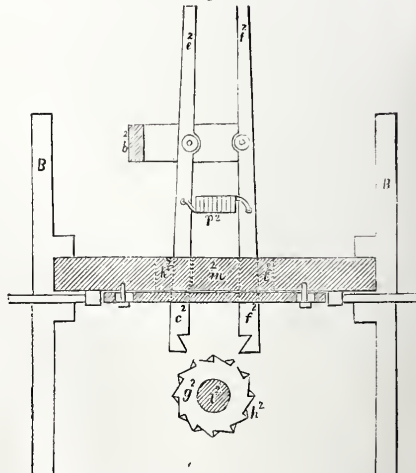


Fig. 11.



cept so far as the arrangement of the gear or pinion B and the joints *xxx*, &c., of the chain belt is concerned. On the main driving shaft, there is another cam,

*a*², which operates against the upper end of a lever *b*², which turns upon a fulcrum *c*². See figure 10, which is a transverse section of the machine, taken

Fig. 10.

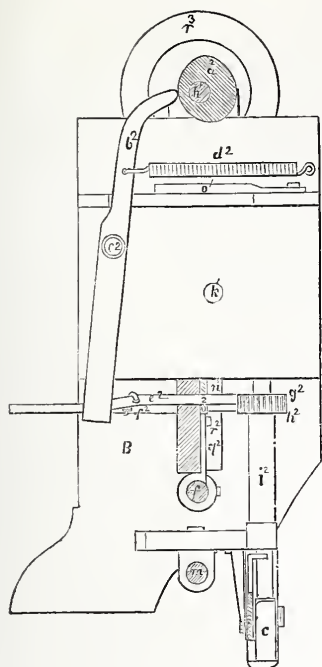
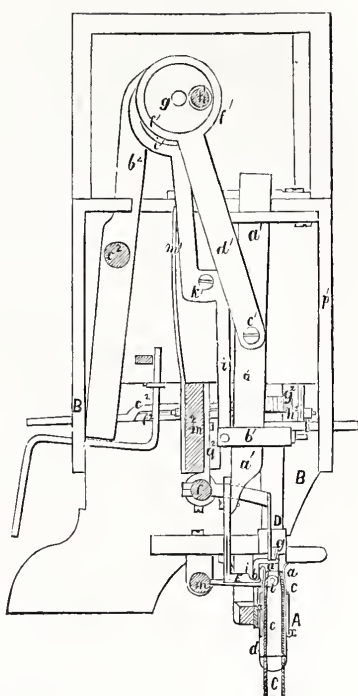


Fig. 2.



through such cam, and looking towards the right, serves to show the machinery actuated by it. A spring d^2 is used to draw the upper end of the lever against the cam. The lower end of the lever is bent at right angles, or horizontally, and has two impelling pawls $e^2 f^2$ jointed to it, and made to extend forwards and respectively to act in concert with two ratchet wheels $g^2 h^2$, fixed upon the upright shaft i^2 of the pinion b , which works the chain belt. These ratchet wheels and pawls are seen in fig. 2 and 11, the latter figure being a horizontal section of the machine, taken just above the pawls, and so as to exhibit them. The teeth of one of the ratchet wheels are arranged in a direction opposite to those of the other—in order that when its pawl is in action with it, a motion of the shaft i^2 may be produced in a direction the reverse of that effected by the movements of the other pawl and its wheel. By the movement of either pawl

an intermittent rotary motion of the shaft i^2 will take place.

The two pawls pass respectively through slots $k^2 l^2$ made in a vertical stationary plate m^2 ; see fig. 12, which is a front view of the plate m^2 and the shifting contrivance attached to it. Such shifting contrivance is a slide n^2 , which is capable of being moved longitudinally, and has a projection o^2 extending down between the two pawls. When the slide is moved in one direction, it bears against one of the pawls, and throws it out of action upon its ratchet wheel, and at the same time, in consequence of the two pawls being connected by a spring p^2 , it draws the other pawl against the other ratchet wheel, thereby creating a reverse motion of the shaft i^2 . The object of the two pawls is to enable the movement of the endless belt A to be reversed, so as to cause the knitting to be produced in an opposite direction; one pawl, however, is sufficient to produce

the movement necessary to knit in one direction.

The shaft f , which carries the yarn director D , is made to slide longitudinally in its bearings, and is connected into the slide n^2 by a lever q^2 , which turns upon a fulcrum r^2 and has its ends inserted in notches made in the slide n^2 and the shaft f , and this so that the movement of the slide in one direction may create a sliding movement of the shaft, sufficient to move the yarn guide into the proper position to commence the knitting in the reverse direction.

The shifting contrivance may be operated by the attendant, or by any other proper means. Some parts of other mechanism which I append or attach to the above described machine, and for purposes not necessary to mention, may be seen in the drawings. As such mechanism forms no part of my invention, I make no further reference to it or description of it.

On the driving shaft there may be a fly wheel r^3 , from which a crank s^2 may extend, and for the purpose of enabling a person to put the shaft in motion — or the said shaft may be revolved by a pulley applied to it, and made to receive an endless belt from any suitable driving drum.

By having the endless chain of needles made and operated in the above described manner, the chain extends *around the work*, instead of the work *encompassing the chain*, as it does in other well-known knitting machines. My improved arrangement and disposition of the work exposes all the joints of the links of the chain so that a workman or attendant can readily remove one or more of the needles, with much greater convenience than can be done on the said well-known machines, as in the latter he would be obliged to wholly or partially *remove the work from the needles* in order to accomplish the addition or subtraction of one or more of the needles, such addition or subtraction being for the purpose of enabling him to "*widen*" or "*narrow*" the work. My improvement affords great advantages in knitting a heel, as the same can be effected in a much more perfect manner, without that strain upon the work and needles that is incident to the old and well-known machines.

DIMPFL'S IMPROVEMENTS IN STEAM ENGINES.

From the Specification of the Inventor, Frederick P. Dimpfel, of the city of New York.

In the accompanying drawing, fig. 1 is a side elevation of such parts of a steam engine as are deemed necessary to elucidate the nature of my improvements thereon. This engine is represented as standing vertically, although its position may be altered without changing the nature of my improvements, but this vertical position is to be preferred, where there are not any serious obstacles in the way of adopting it.

AA is the steam cylinder, B the piston-rod, and C the cross-head, a top view of which latter is given in fig. 2. D is a slide upon the cylinder, there being another upon its opposite side. Fig. 3 is a top view of the cylinder, and of two metallic rings, or belts, which surround it, and which are to play up and down with the piston; one of these rings EE being attached to the cross-head by the side rods FF, of which there are four; the cross-head CC being bifurcated, or divided into two parts, at each of its ends, as shown at GG, fig. 2, the sides of the connecting rod NN, to be presently described, passing alternately into the spaces GG in the cross-head, as the crank revolves, and the piston reciprocates. DD are guide blocks attached to, and making a part of the vibrating ring EE, and which embrace the slides DD, and thus serve to cause the cross-head and piston to move vertically.

Should it be found necessary, a parallel motion may be attached to one of the ends of the cross-head, to cause it to work steadily. Under the foregoing arrangement, the cross-head is made to stand at right angles with the crank shaft; this being necessary in order to allow it to pass up between the cranks, and to effect the saving of room consequent thereon.

I is the crank standing immediately over the cylinder; J one end of its shaft, and K one of its pillow blocks. LL are columns which support the cap-pieces M and the pillow-blocks K. There are four columns LL, two on each side of the cylinder. NN is the connecting rod, which, instead of consisting of a single bar, is forked in the manner represented in the drawings, its stub-end embracing

Fig. 1.

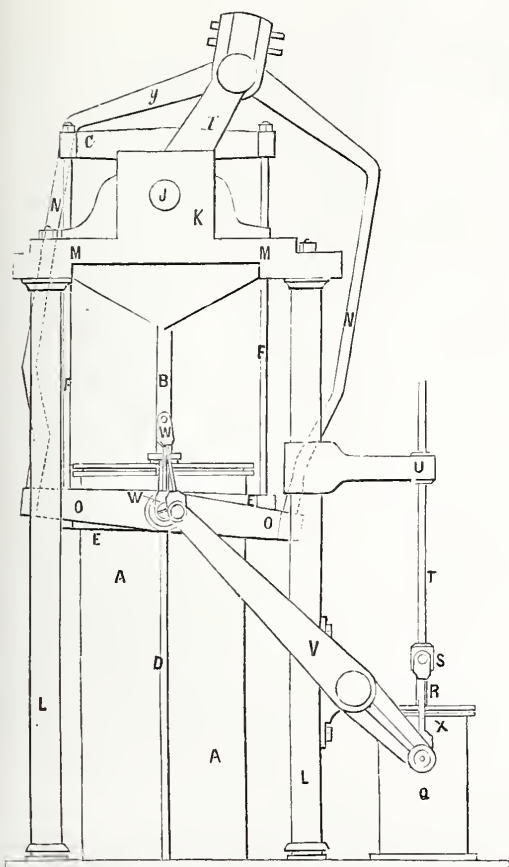


Fig. 3.

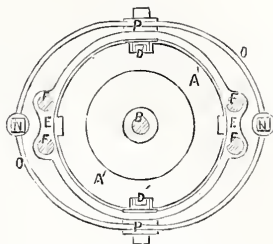


Fig. 6.

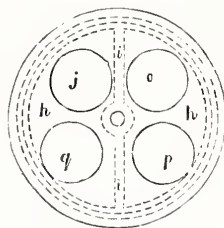


Fig. 2.

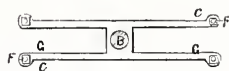
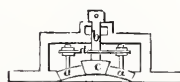


Fig. 4.



the crank, its cross-piece *y* standing transversely to the crank-shaft, and its two bars *NN* extending downwards, on opposite sides of the cylinder. This connecting rod will, at its upper end, vibrate from side to side, to a distance equal to the throw of the crank, and it is to admit of this vibration that the ends of the cross-head *c* are bifurcated, the bars *NN* passing alternately into the spaces *g g*. The lower ends of the bars *NN* of the connecting rod are attached to a ring or belt *o o*, which surrounds the ring or belt *EE*; these two rings are connected together by joint pins at *PP*, in the manner of gimbals. The cylinder *Q* represents that of an air-pump, the piston and piston-rod *R* of which may

be carried by a cross-head *s*, the rod *T* being a slide-rod passing through a socket at *U*, there being a similar slide-rod and socket on the other side of the piston-rod *R*. *V* is a vibrating lever, connected by link-rods *w* to the vibrating rings or belts *EE*, and by link-rods *x* to the air-pump cross-head *s*. The air-pump, when one is used, may be otherwise arranged, my improvements not depending upon the particular manner of combining this with the other parts of the engine: I have contemplated the forming of the lower part of one of the columns *L* into a condenser, and another into a hot well, which can be readily effected by any competent machinist, should such an arrangement be deemed

Fig. 5.

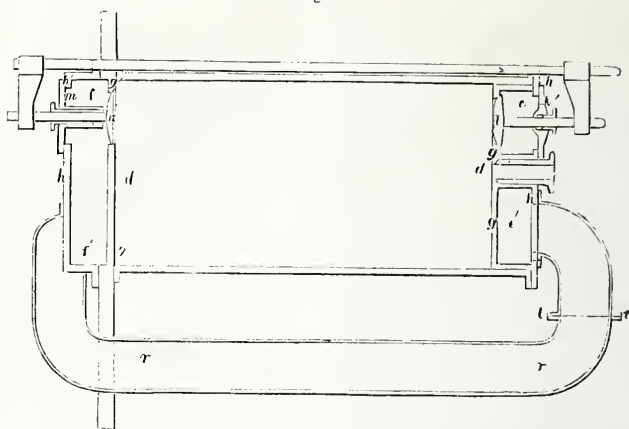


Fig. 7

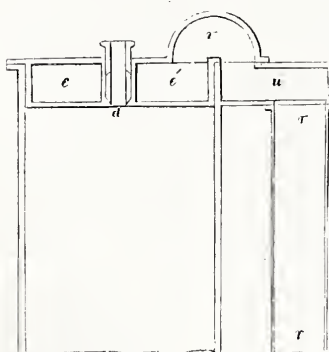
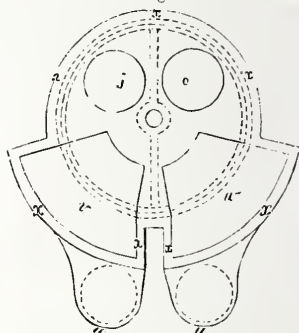


Fig. 8



eligible. Under the foregoing arrangement it will be seen that as the crank shaft is made to revolve, the rings or belts *E* and *O* will be moved up and down on the outside of the cylinder, being guided by the slides *D D*.

In fig. 4 of the accompanying drawing, I have represented an improved puppet valve, such as is attached to my steam engine, the object of which improvement is to cause it to offer less resistance in opening under the pressure of steam, than that to which it is ordinarily subjected. In this figure *aa* is a puppet valve resting on its seat; *b* is the valve stem, and *c* a small valve, of which the larger valve *a* constitutes the seat. When the stem *b* is raised, the valve *c* will be lifted, and this may have a play of half an inch, more or less, before it

comes in contact with the bar or cross piece *d*, attached to the main valve, which it will then lift; the raising of *c* will allow steam to pass through its seat, and under the main valve *aa*, which will consequently be lifted with facility.

The within described manner of connecting the steam piston of an engine with the crank, adapts it in an especial manner to marine purposes, as will appear by the following comparative dimensions and weight of the engine placed on board the steamship *Mississippi*, and the dimensions and weight of one of equal power, if constructed on my plan: and results equally favorable might be obtained, by comparing my engine with those of equal power on board of other steamships.

	Engine of the Mississippi.	My new arrangement.	Differ- ence.
Total length of boiler, and engine, - -	75 feet.	61 feet.	14 feet.
Length of engine in hold, - - -	29 "	15 "	14 "
Length on berth deck, 29 "		10½ "	18½ "
Moving weight, 55,000 lbs.		25,262 lbs.	29,738 lbs.
Total weight, 110,000 "		50,524 "	59,476 "

From the foregoing it will appear that, besides the great and important saving in room, the total saving of weight in the whole ship will be nearly thirty tons; and, in addition to the foregoing advantages, the arrangement described by me presents fewer friction points, is more simple, and relieves the ship entirely from strain by the direct application of the power. A much longer stroke of the piston is obtained by it than upon any other known plan. The length of the stroke of the piston in the engine of the Mississippi is seven feet, whilst in mine it will be ten feet—thus permitting me to employ a crank of five feet radius, instead of one of only three and a half feet.

From the peculiar compactness of my arrangement, it may be used on board of sailing vessels of the best form, without interfering therewith; and, should it be found convenient to change its position, and to work it either horizontally or obliquely, to adapt it to submerged propellers—all advantages derivable from its compactness and diminished weight, will still be retained.

In the accompanying drawings, I have also shown an improved manner of arranging and combining the steam-pipes, steam-chests, and valves: it is as follows. Fig. 5 is a sectional representation of a steam cylinder, having, at its upper and lower ends, cylinder heads of a peculiar construction, each of them being so formed as to constitute two chambers, one of which is an induction, and the other an eduction chamber; *dd* is the cylinder, and *e e'*, *f f'*, are steam chambers formed in the cylinder heads, each of which heads consists of a double plate *g g'* and *h h'*. In each of these heads there is a partition which divides the space between the two plates into two semicircular chambers.

Fig. 6 is a top view of the upper head; the partition which divides the space between *h h* and *g g* into two being shown by the dotted lines *i i*; *j* is an opening which, in fig. 5, is shown as covered by a cap *k*, having in it a stuffing-box for the

passage of the stem of the valve *l*, which valve has its seat in the plate *g*, and opens upwards; *m* is a plate in the lower head similar to that marked *k* in the upper; and *n* a valve in the plate *g'*, also finished with a stuffing-box, and opening upwards.

The opening *o* in the plate *h*, fig. 6, is similar to the opening *j* in its office—that is to say, it is situated directly above two valves, in the respective plates *g* and *g'*, but operating in a direction the reverse of that of the valves *l* and *n*—that is to say, the uppermost valve opening downwards, and the lowermost opening upwards. The openings *p* and *q* in the plate *h h* are for the reception of the induction and eduction pipes, one of which is shown at *r r*, fig. 5, and the other, not shown, being similar thereto. The induction and eduction pipes cross each other below the lower head, as they have to connect with the reverse chambers in the upper and lower heads. The valve-lifter *s s*, fig. 5, rises to admit the steam into the cylinder, supposing the space *e* to be operating as an eduction chamber; the valves in the opposite chambers, which are supposed to be under the opening *o*, will, on the contrary, have the rod corresponding with *s s* to move in the reverse direction to effect the same purpose.

In the arrangement of the upper head, as shown in fig. 5, said head cannot be removed, so as to get at the piston, without disconnecting the steam and eduction pipes at the part where they are joined by flanches, as at *t t*, which is attended with considerable inconvenience; but this may be obviated by the peculiar manner of constructing and putting on the upper head, as represented in figs. 7 and 8. The general arrangement of the chambers, valves, induction and eduction pipes, is the same with that above described and represented in figs. 5 and 6. In fig. 7, *d* is a sectional view of a part of the cylinder, *e e'* the steam chambers, and *r r* a steam-pipe. This steam-pipe enters a small chamber or nozzle *u*, two of which are cast on to the cylinder, as indicated by the letters *u u* in fig. 8. This last figure represents the top plate of the head, corresponding with *h h* in fig. 6; *v* and *w* are two arched spaces, which constitute steam-ways leading from the induction and eduction pipes into the re-

spective chambers. By passing screw-bolts through the edges $x x$ around this head-plate, and through flanches cast on the cylinder in the ordinary way, said plate may be secured in place, and it may be removed with the same facility as the heads of other cylinders.

By this arrangement of the heads and other parts, there is a great saving effected in the steam admitted at every stroke of the cylinder—such saving being equal to one-fifth, or nearly so, when this improved mode of arrangement is compared with that which is usually adopted. The steam contained in the steam nozzles or passages leading from the valve seats to the head of the cylinder, as formed in the ordinary engines, is, by this arrangement, entirely saved. The valves in the plates $g' g'$ are flush, or nearly so, when closed, with the internal faces of those plates or heads. It will be manifest that slide-valves might be substituted for the puppet-valves herein spoken of, whilst the general arrangement of the parts upon which this improvement is mainly dependent might remain unchanged.

It is evident that the construction and arrangement of the valves and valve chambers above described will not affect the method I have described of connecting the steam piston and crank, and that this method may be used in connection with valves and valve chambers differing in construction and arrangement from those described in this specification.

In the foregoing description I have stated that the cross-head of the steam-piston is forked at its opposite extremities, to allow the bars of the forked connecting-rod to play through it. It is evident that the same result will be obtained if the cross-head is made single, and the side-bars of the connecting-rod are forked to embrace its opposite extremities, this arrangement being, in fact, the converse of the one I have described.

What I claim as my invention, is the method herein described of connecting the steam piston of a steam engine with the crank thereof, by means of a piston-rod, fixed cross-head, side bars, forked connecting rod, and belts, or the equivalent thereof, these several devices being arranged and operating substantially as herein set forth, in such manner that the cross-piece of the connecting rod which

is placed transversely to the crank shaft, shall be on opposite sides of the axial line of said shaft, at opposite extremities of the stroke of the piston.

I also claim the belts or gimbal rings, or the equivalent thereof, for the purpose of transmitting the movement of the cross-head to the connecting rod of a steam engine.



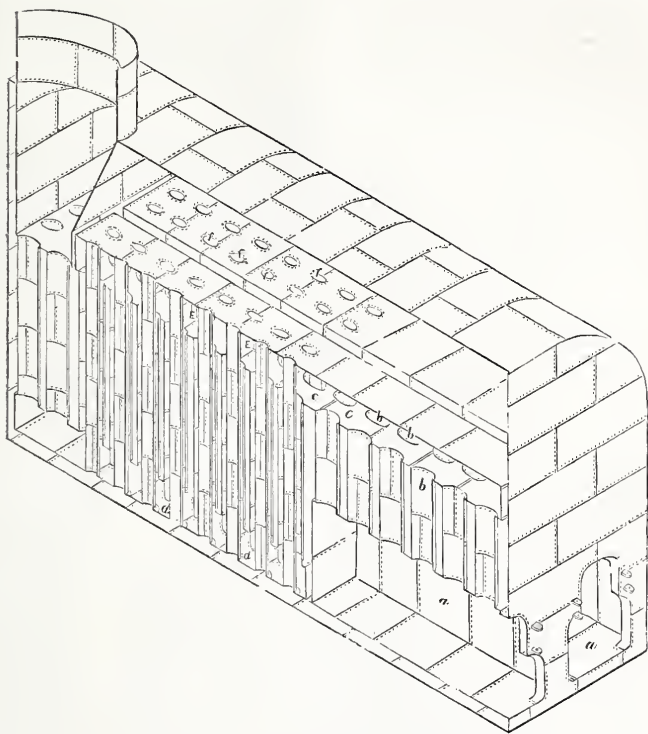
MILLIGAN'S IMPROVED STEAM BOILER.

From the Specification of the Inventor, W. E. Milligan, New York City, patented Jan. 15th, 1851.

The figure is a view in perspective of the interior of the boiler.

The nature of my invention consists in a new arrangement of flues, tubes, and water spaces within a boiler for generating steam, whereby I am enabled to present a much enlarged amount of surface to the action of heat.

The construction is as follows: The general external appearance of my boiler is as of usual make, as is also the construction and arrangement of the furnace within it, but upon the upper side of the fire-place, a , I place a series of flues b , of a number and capacity sufficient to carry off readily the product of combustion from the furnace. These flues open into a horizontal flue c , which is placed above the furnace and below the water line of the boiler. Back of the furnace a , and near the bottom of the boiler, is another horizontal flue d , and between the horizontal flues is a series of vertical flues, similar to the flues b , but necessarily longer as shown at e , and these flues are for the purpose of conveying the products of combustion from the upper to the lower horizontal flue. Through the centre of each of the vertical flues e , I place a tube f , of, say one-half the diameter of the flue, and these tubes extend from the upper tube-sheet of the horizontal flue c , through the lower tube-sheet of the flue d , as shown. The water passes through these tubes, and the purpose of them is to present greater surface for the absorption of heat, as well as to insure the circulation of the water within the boiler. From the lower horizontal flue d , the product of combustion is either conveyed directly into the chimney, or it may be returned to another upper flue c' , through the flues e' ; thence



again to another lower flue *d*, through the flue *e*"; and thence into the chimney by means of the flues *b*, as shown, one, two, or more furnaces arranged with flues and tubes thus constructed may be placed within the same shell, sufficient space being left between them as shown, for the circulation of the water.

The practical operation is thus: the water in the boiler rising above the upper horizontal flues fills the tubes *f*, and surrounds all the flues. The product of combustion passes from the flue *c* through the vertical flues, *e*, parting with its heat on the one side to the water surrounding those; and on the other to the water within the tube *f*. The water contained in the tubes is much more rapidly heated than that surrounding the flues as its volume is less, and hence by known laws a regular and perfect circulation takes place within the boiler.

I do not mean or intend to limit myself to the precise form of construction herein set forth, as it is obvious that if desirable the flues *c* and *d* may be placed vertically, and the others may be horizontal.

What I claim as of my own invention is the general arrangement of the tubes and flues of the boiler in the manner described; that is to say, the water tubes connected with the upper and lower tube sheet, in combination with the flues of less length than the tubes, which flues are also connected with an upper and lower flue sheet, whereby two horizontal flues are formed in such connection with each other by means of the vertical flues, that the product of combustion from the fireplace shall pass into the upper horizontal flue and thence down the vertical flues into the lower horizontal flue, having thus the facility of parting with its heat

on the one hand by radiation through the flues to the water spaces surrounding them, and on the other through the tubes to the water circulating through those; and this, whether the said tubes and flues are placed vertically or horizontally.

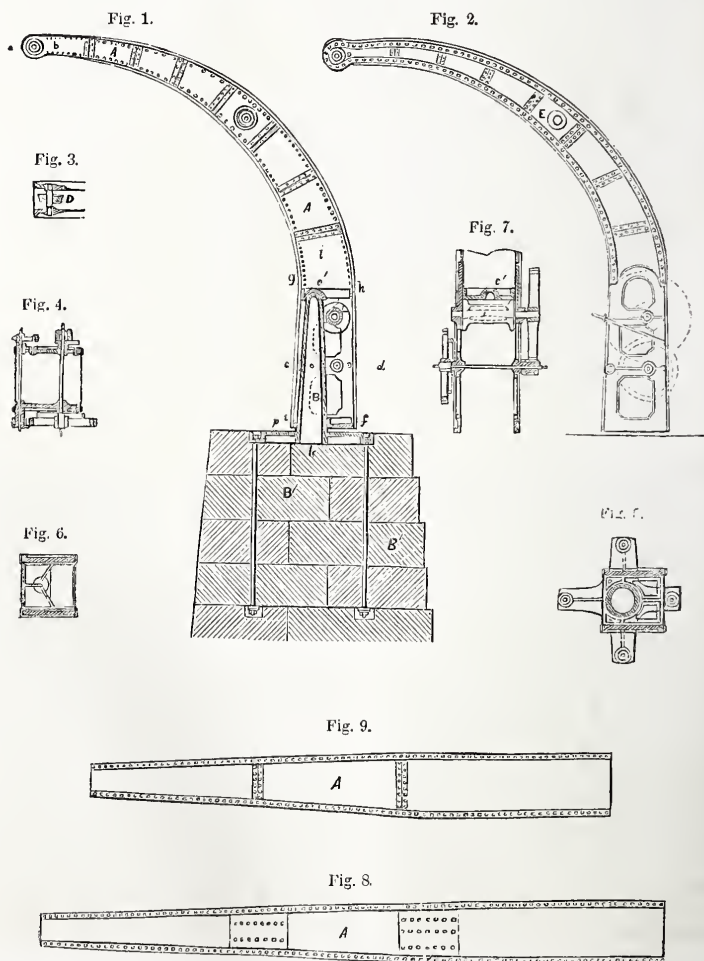
MR. FAIRBAIRN'S PATENT TUBULAR
CRANES.*

(Patent dated November 1850. Specification enrolled
May 7, 1851.)

My improvements in cranes and other
lifting and hoisting machines consist in

constructing the jib of such machines of metal plates, so arranged and combined as to form a connected series of tubular or cellular compartments, instead of forming the jib of one solid piece, as heretofore.

Fig. 1 is a vertical section of a crane constructed according to my said invention, and calculated for lifting or hoisting weights up to about eight tons. Fig. 2 is an elevation of the same; figs. 3, 4, 5, and 6, are cross sections on the lines *ab*, *cd*, *ef*, *gh*; and fig 7 a transverse vertical section on the line *ik*. *AA* is the jib,



* From the London Mechanics' Magazine.

Fig. 10.

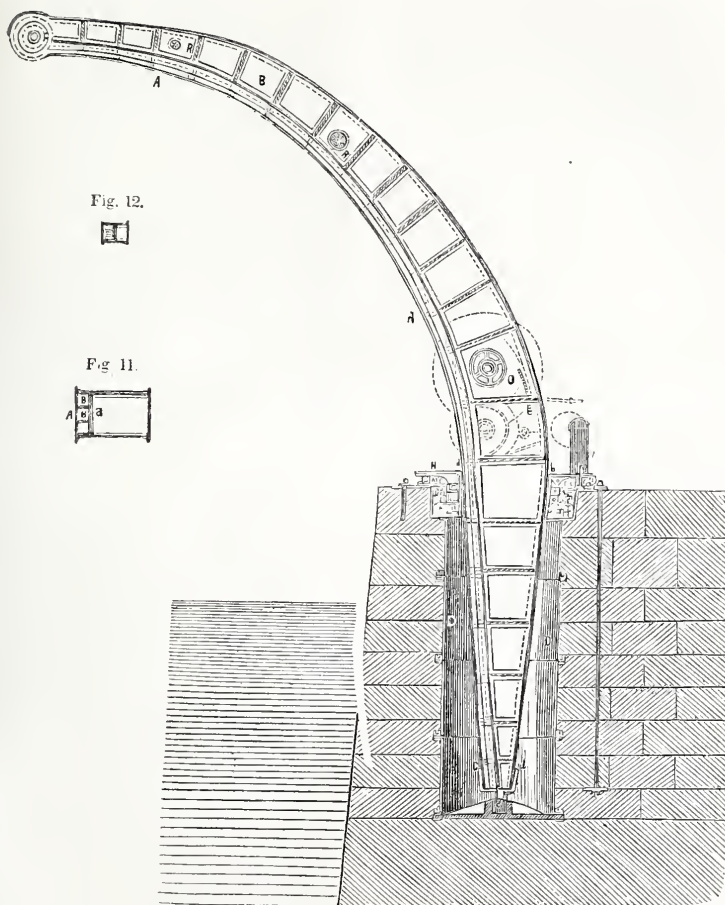


Fig. 12.

Fig. 11.

which, in its general outline, is of a crane-neck form, but rectangular in its cross sections, as particularly shown in figs. 4, 5, and 6. The four sides are formed of metal plates firmly riveted together. Along the edges, the connection of the plates is effected by means of pieces of angle iron. The connections of the plates at the cross joints, on the convex or upper side of the jib, are made by the riveting on of a plate which covers or overlaps the ends of the two plates to be joined; the rivets at this part are disposed as represented in fig. 8 (a plan of the top plates), and known as "chain riveting." BB is the pillar, which is firmly secured

by a base plate *p*, to a stone foundation B,¹ and fits at top into a cup-shaped bearing *c*¹, which is firmly secured to the side plates of the jib, at or near to the point where the curvature commences, and on which bearing the jib is free to revolve. Fig. 7 is a transverse vertical section of the lower part of the jib, showing the manner of fitting the bearings for the chain barrel, (which is placed in the interior,) and the spindles and shafts of the wheel gearing by which the power is applied thereto. D is the chain pulley, which is inserted in an aperture formed in the top of the jib. The chain passing over this pulley enters the interior of the

crane, and is continued down to the chain barrel. *E* is a pulley or roller, which is interposed about half way between the chain pulley and the chain barrel, for the purpose of preventing the chain rubbing against the plates. Fig. 9 is a plan of the lower plates.

Fig. 10 is a vertical section of another crane, constructed upon the same principle as that which has just been described, but calculated for lifting much greater weights (say twenty tons); it differs in having the lower or concave side *AA* of the jib strengthened by means of three additional plates *B, B, B*, whereby the interior is divided into one large and three smaller cells, as shown in figs. 11 and 12, which are cross sections upon the lines *ab* and *cd* of fig. 10. This arrangement of the cells to strengthen the lower or concave side is advisable, in order to obtain sufficient resistance to the compression exerted by the load lifted, without unnecessarily increasing the weight of the other parts. The tension exerted upon the upper or convex plates does not require so much material to withstand it. *C* is the toe of the jib, which rests in a step formed in the bottom of the cylindrical casing *D*, which is built into the masonry forming the basis of the machine. *EE* are two of a set of pulleys which are mounted between two rings *FF*, and serve as antifriction rollers for the upper bearing of the jib. The lowermost of the rings *FF* rest upon a set of rollers *GG*, which are fitted into the top of the casing *D*, so that, as the jib is turned round, the rings *FF*, and the antifriction rollers which they carry, have perfect freedom to move along with it; *H* is a platform, upon which the persons working the machine may stand, and which supports a column *I*, within which there is mounted a spindle *K*, the lower end of which has keyed to it a pinion *L*, which gears into a circular rack *MM*, bolted to the top of the cylindrical casing *D*. *N* is a worm wheel keyed to the top of the spindle *K*, into which an endless screw, worked by a hand wheel, is geared, so that, by turning the hand wheel, the jib of the crane is made to move round in any required direction. *O* is the chain barrel; *P* the chain wheel; *RR* pulleys or rollers which support the chain, and prevent its rubbing against the plates of the jib.

In the cranes and hoisting machines which I have described, the chain barrels are inclosed within the jib, and the spindles of the wheel gearing are also inside; and this is the disposition of these parts which I prefer; but it will be obvious that they may be also placed outside of the jib, in a manner similar to that generally followed in the construction of ordinary cranes.

And having now described my said invention, and in what manner the same is to be performed, I declare that what I claim is the constructing of cranes and other like lifting or hoisting machines, with jibs composed of a series of metal plates, arranged and combined so as to form a connected series of tubular or cellular compartments, as before exemplified and described.



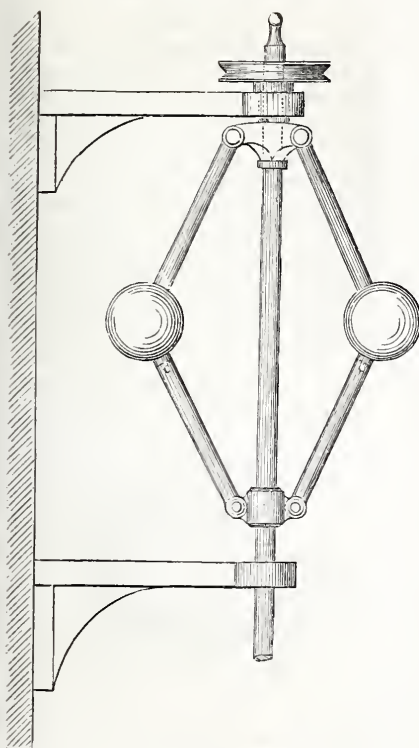
CORLESS'S IMPROVEMENT IN GOVERNORS.

From the Specification of the Inventor, Geo. H. Corless, Providence, R. I., patented Jan. 10th, 1851.

Governors in general, and particularly the fly-ball governor, are subject to a defect which materially affects their efficiency; this defect consists in a tremulous movement, or, as it is commonly called, fluttering, in moving in either direction from a central or mean point. This fluttering is particularly objectionable in governors applied to steam engines where the slide of the governor in moving varies the quantity of steam admitted to the cylinder, and where consequently the fluttering of the governor produces a corresponding irregularity in the power exerted by the engine. The object of my invention is to obviate this defect, and it consists of an apparatus which, when applied to a governor, causes its slide or the equivalent thereof to vary in either direction from a mean point, with a regular and equable movement as applied to a fly-ball governor.

This apparatus, as represented in the accompanying section, consists of a cylindrical vessel, *A*, which is fitted with a piston *B* that moves loosely within it, a narrow annular space *C* intervening between the periphery of the piston and the sides of the vessel. The piston is secured to a piston rod *D*, which is connected with the slide or other varying

Fig. 1.



of speed, its upward movement is resisted by the water in the vessel, which as the piston rises passes round it to fill the space beneath left void by the rising piston, and when the slide of the governor is lowered, its downward movement is also resisted by the water beneath the piston, which must be forced around the piston as the latter is lowered. As the space surrounding the piston through which the water must pass is narrow, the movements of the piston are necessarily regular, for the water cannot move from one side of the piston to the other with sufficient velocity to permit the piston to flutter. As the slide of the governor is connected with the piston, its movement is steadied by that of the piston, and the fluttering motion which has heretofore been so objectionable is done away.

The apparatus I have described may be modified, in form, arrangement, and construction, to suit particular cases, or to meet the views of different constructors; thus, for example, any suitable fluid may be substituted for the water described, and the apparatus, instead of consisting of a reciprocating piston moving in a cylinder, may take the form of a vibrating piston or paddle moving in a trough containing water, oil, or some other liquid.

EQUILIBRIUM LUBRICATOR.

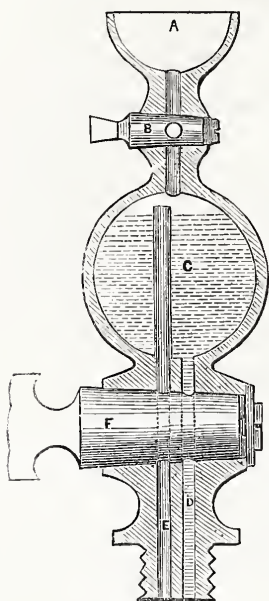
W. C. Morton, Engineer, Burnham, Bucks.

This lubricator has been contrived for the more effective application of oil to machinery, where the oil reservoir is subjected to steam pressure; as, for example, in lubricating a steam engine cylinder. Our engraving represents a vertical longitudinal section of the lubricator, as adapted for such a purpose.

The lubricator is fed by the supplying cup A, the passage from which is regulated by the stop-cock B, here shown as closed. From this cup the oil flows directly into the spherical reservoir C, shown in the figure as nearly filled. D is the channel conducting the oil from the bottom of this reservoir, through the lower branch or pedestal of the lubricator, to the point of lubrication. This lower part is made of sufficient diameter to admit of a second and parallel passage E, continued upwards within the reservoir, so that its open top stands nearly

member of the governor, so that as the latter rises and falls with changes of speed, the piston is moved in a corresponding manner. When the apparatus is in use the cylindrical vessel is nearly filled with water, as represented in the accompanying drawing. If now the slide of the governor be raised by an increase

level with the top of the reservoir, and above the level of the contained oil. Both passages are governed by the stop-cock F, formed with a double bore to correspond to them.



We have supposed the apparatus to be fitted on to a cylinder cover, to supply oil to the piston in the interior. When oil is to be fed into the reservoir, it is poured into the cup A; and the stop-cock B being opened, the fluid descends to the reservoir C, its stop-cock being closed. The position of the stop-cocks is then reversed, the upper one being closed, and the lower one opened. The result of this movement is, that as both the passages D E open into the steam cylinder, steam immediately rushes up the passage E, and pressing on the surface of the oil in the reservoir, balances the upward steam pressure by the oil passage D. In this way, an equilibrium is established, and the oil descends simply by its own gravity, and finds its way into the cylinder. With very little additional work, this lubricator is a vast improvement upon the ordinary oil-cup.—*Glasgow Practical Mechanic*.

CLEAR WAY VALVE.

J. B. Davis, London.

The name which Mr. Davis has chosen for his invention, in itself indicates the point of improvement, namely, the securing a clear water-way, an object of no easy attainment in ordinary stop-cocks. In the engravings, fig. 1 is a side elevation of the valve, and fig. 2 is a corresponding longitudinal section. In this example, it is represented with screwed connections, but it is obvious that it may be made in a variety of ways to suit any particular purpose, such as with tinned ends for a stop-valve, or with a bib-nose flanges or sockets.

Fig. 1.

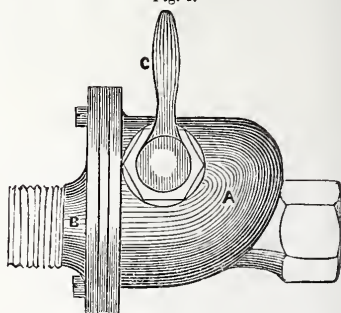
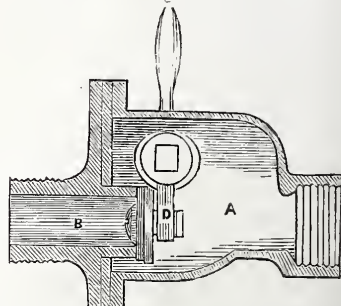


Fig. 2.



The end A is the inlet, the discharge being by the passage B; the two divisions being held together by bolted flanges. The part A of the shell has formed upon its side a stuffing-box to receive the short horizontal spindle employed in actuating the valve, the movement being communicated by the lever-handle C. This spindle has a square upon it, and on this part

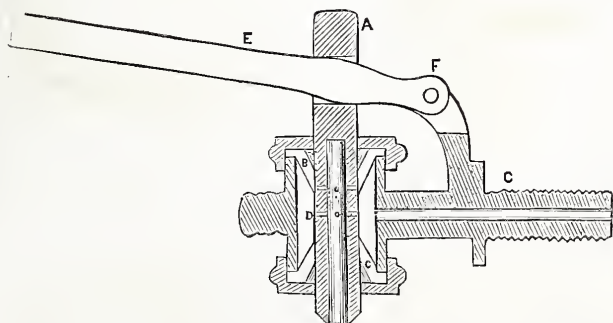
is placed the short lever *D*, which enters a slot in a tail-piece cast on the valve. The valve is simply a metal disc, faced with vulcanized india-rubber, held on by a screw on the face side. It is supported by two side arms, bored out at their upper ends, with oval holes, by which it is suspended from the actuating spindle above, the oval being necessary to allow the valve to have free motion on its spindle. In the section, fig. 2, the valve is delineated as closed; to open it, nothing more is necessary than to bring down the lever *c* towards the outlet end, when the valve will be raised clear off its seat, giving a full and direct water-way.

With this kind of seat, the valve is only suited for cold fluids. For hot water or steam, the india-rubber face must be replaced by a conical metallic face ground to fit. The inventor states that the range of sizes of this valve extends from half inch to 12 inch bores.—*Glasgow Practical Mechanic*.

STOP-COCK.

Messrs. Stock & Sons, Birmingham.

Messrs. Stock & Sons propose to diminish the risk of leakage in valves of the stop-cock class, by the adoption of double conical leather-washers for the working surfaces, instead of metal. Our engraving shows the new cock in vertical section. The plug, *A*, is hollow through the greater part of its length, its upper end being solid, and having an eye formed in it for giving it motion; *B*, *c*, are two conical leather-washers contained in the chamber, *D*, the two end covers of which are bored out to admit the plug, such covers answering to hold the two washers. The plug is actuated by the hand-lever, *E*, passed through the eye, and hinged at *F*, to a short pillar cast on the inlet branch, *G*, of the valve. A ring of holes is formed in the tubular portion of the plug, by which a water communication is formed at pleasure, between the shell and the bore of the plug.



In the figure, two sets of holes are shown. The upper set represents their position when the valve is closed by the elevation of the plug and lever, so that the upper leather cone, *B*, shall envelope the holes, and thus close the communication with the interior. The lower set is added to the sketch, to show how the descent of the plug, consequent upon the depression of the actuating lever, uncovers the holes, and allows the fluid to flow from the shell, and escape by the open lower end of the plug, which is the outlet of the valve. If the plug is pushed lower down, the holes will be similarly enveloped by the lower cone, *c*, so as to stop the flow, the valve being full open only when the lever *E* is horizontal. As the

shell is always full of water, whatever fluid pressure may be exerted, can only tend to press the leather cones into closer contact with the surface of the plug, and resist all leakage.—*Glasgow Practical Mechanic*.



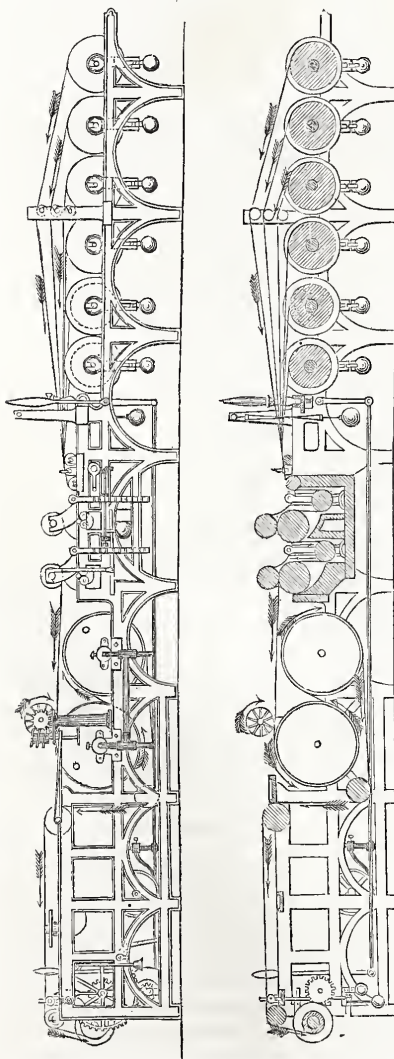
KENWORTHY AND BULLOUGH'S PATENT POWER-LOOM.

It will be recollected that, in the July number of the Magazine, our London correspondent makes mention of a fine power-loom in operation at the Crystal Palace. The drawing came too late for insertion in that number, but is added

here, and is known as Kenworthy and Bullough's Patent Power Loom.

The following is a brief recital of some of the leading advantages possessed by this loom, viz. :—

1st. The TAKING-UP MOTION, for effecting the coiling up of the cloth, is perfectly
Longitudinal Elevation. Section.



uniform; it can be readily varied to suit any required number of picks; and these are obtained with the greatest regularity in "count," without being subject to the slightest variation through negligence or inattention of the weaver.

2d. The Taking-up Motion is much simpler, more durable, and not so liable to get out of order as the one in common use; it is disengaged the moment the weft thread breaks, or made to RECOIL, and thereby the progress of the warp is instantaneously stopped.

3d. The ordinary temples are dispensed with, and are substituted by a simple self-acting application, by which the cloth is kept distended at one uniform breadth, and made entirely free from pin perforations or temple tears, and the selvages are made beautifully uniform and good.

4th. The loom will not go without weft, being thrown out of gear by the first absent pick. This arrangement greatly protects the sides of the warp from breakage, consequent upon a loom going without weft, and dispenses with much of the care and watchfulness upon the part of the weaver.

5th. Looms on this principle weave better, and make very superior cloth to a common loom; they are simple in construction and application—are attended with a saving of power—less wear and tear; they produce fully more work, and of much better quality than common looms, and therefore cannot fail, with fair arrangements, to work out advantages which must ultimately be productive of great benefit both to the employer and employed.

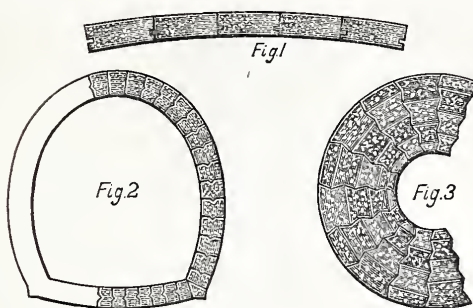
6th. These improvements can be applied, at a moderate cost, to all looms now in use.

STONE AND IRON CONGLOMERATE.

Patented April 1st, 1851.

For Appleton's 'Mechanics' Magazine & Engineers' Journal.

This new branch of manufacture, the invention of George H. Knight, of Cincinnati, is intended for use in those structures which require an elaborate, or skillful fitting of the contiguous blocks, and especially such as are subjected to great strain or violence, such as lighthouses, sea-walls, break-waters, coffer-dams, bridge piers, prison cells, bank vaults,



tramways, city paving, &c., as well as for casing of shafts, railroad tunnels, &c.

The advantages claimed for this novel description of building material are:

Its great tenacity and strength.

Facility of moulding to any form desired, including dovetails or other devices for jointing and interlocking. In the case of paving and tramways, the refractory character and diversity of its materials preventing it from wearing smooth.

When used in prison cells or bank vaults, being practically impervious to any tools.

Fig. 1 is a course of paving, of which the contiguous blocks are interlocked by tenon and mortice, distributing the pressure over a large surface.

Fig. 2 shows the plan as applied to a tunnel.

Fig. 3 is a course of masonry on the plan of the Eddystone light-house, in which, as is well known, the stones are so shaped as to interlock or dovetail into each other, so as to approximate to the character of a solid mass.

In the use of stone in such structures, laborious and skilful fitting is involved, which is superseded by this system, all that is required after the patterns are made and moulded, consisting in filling up the mould with broken stone (previously gradually heated) and running the molten metal among the mass; the metal fills every interstice between and around the stones without disintegrating them, making a sort of honeycombed substance, in which the comb is represented by the iron, which, being in one continuous reticulated mass, forms a bond of union, and gives to the conglomerate

not only a great power of resisting compression, but also a considerable degree of tensile strength.

Where piers or cramps are employed, one end is cast in its place within the block, and a socket formed for the other end in the counter block by means of cores. Thus the laborious process of drilling for the insertion of these connections is avoided, and in the process of treenailing and joggling the stones to those adjacent, facilities are afforded by the introduction of cores for making the requisite apertures, recesses and grooves. The bulk of granite will be from twice to five times that of the iron, according to the purpose for which it is designed.

The rapidity with which blocks on this construction can be produced and placed in position, seems to be of some advantage in those marine works which can only be carried on at certain stages of the tide.

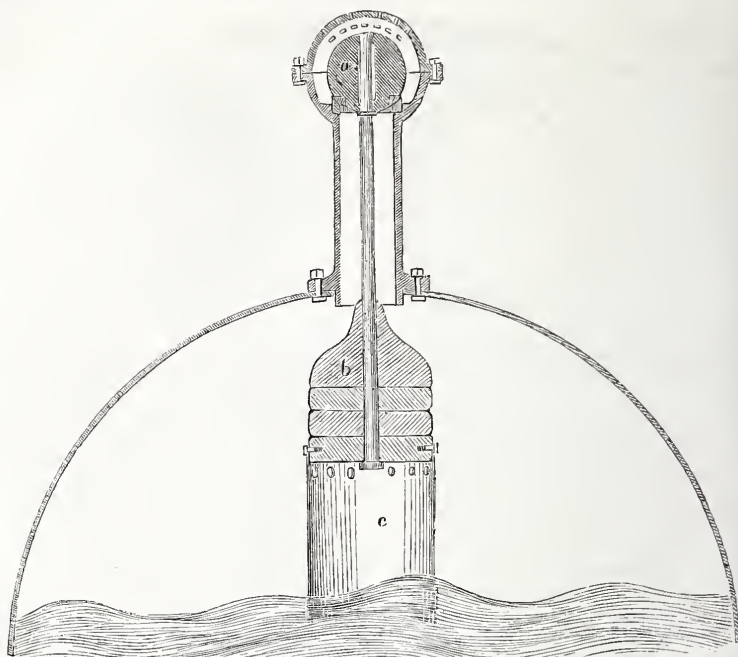


NASMYTH'S ABSOLUTE SAFETY VALVE.

The absolute safety valve, represented in the following figure, has met with very general and high approval, as uniting in a most simple combination all the qualities which can tend to the formation of a true and perfect safety valve.

The total absence of all spindles or other guiding agencies, which have hitherto proved so fertile a source of mischief and uncertainty in the action and permanent perfect condition of this vital part of a boiler apparatus, will be seen at a glance to characterize the design of this "absolute safety valve."

The chief feature of novelty, however, which distinguishes this improved safety



valve from all others hitherto proposed, consists in the peculiar and simple manner in which the motion of the water in the boiler is employed as the agent by which the valve is prevented from ever getting set fast in its seat. The swaying to and fro sort of motion which at all times accompanies the ebullition of water in boilers, is made to act upon a sheet-iron appendage *c* to the weight *b*, which weight is directly attached to the brass valve *a*, and as the rod which connects this sheet iron appendage and weight to the valve is inflexible, it will be easily seen how any slight pendulous motion given to the sheet-iron appendage is directly transferred to the valve; and as that portion of the valve which rests in the seat is *spherical*, the valve not only admits of, but receives a continual slight motion in its seat *in all directions*, as the result of the universal pendulous motion of the appended weight, as acted upon by the incessant swaying motion of the water during ebullition.

Near the top of the cylinder is a row of holes to prevent any accumulation of

steam inside it. When the pressure of steam is near the blowing-off point, it is obvious that the weight on the valve-seat is so nearly balanced that there is but a very small degree of friction to be overcome, and that consequently the valve will be affected by the slightest motion of the water.

It will be seen that as the spherical portions of the valve and seat are of equal width, the edges of their respective surfaces pass and repass each other continually, and so maintain and continually tend to improve the perfect spherical fit and agreement between the valve and its seat. It may be proper to observe that when the steam is near up to the desired pressure, the valve rests on its seat with a pressure next to no pressure at all, and is then, as it were, floating on steam. This action is common to all good valves, but the observation may tend to show how a slight movement of the water affects the valve in its seat.

A writer in the London Mechanic's

Magazine objects to the name assumed by Mr. Nasmyth for the above valve, and remarks as follows:

As the name chosen is one denoting perfection, and one on which the public (knowing Mr. Nasmyth's high standing in the scientific world) may be inclined to rely implicitly, I think we have a right to question the *correctness* of the *term*, whilst we give the fullest meed of praise to the inventor for his ingenuity.

Taking the proportions of the engraving, I conceive the "sheet-iron" attachment to be a tube of 9 to 12 inches in diameter, with apertures round the top; —the proportional *length* is not ascertainable from the sketch or description.

HAS Mr. Nasmyth considered the specific gravity of the iron thus immersed?

I can readily conceive that the question has not escaped his notice; and probably he can show that to be unimportant, which appears to me and to others to be a decided objection.

Supposing the length of the "sheet-iron" to be 6 or 9 inches, the weight *may* be *comparatively* unimportant; but should the water fall in the boiler below the "sheet-iron," then the pendulous motion ceases; but if the "sheet-iron" be long enough to reach to within a few inches of the bottom of a large boiler, so that the rocking motion may be available in extreme cases, I conceive that the *weight increasing* as the *water is decreasing*, is a matter of vast importance, and deserving of Mr. Nasmyth's due consideration, before allowing the public to rely *absolutely* on his modification of one of the most important portions connected with our steam engines.

As an *additional* valve, the arrangement is doubtless good; and I am far from wishing to disparage the invention in thus pointing out what I conceive to be an error of vital importance, and one which may be readily obviated, and the specific gravity made to assist in the opening of the valve when most required, rather than be brought to bear, as it possibly may be in some cases, fatally.

Is it not worthy of consideration whether the incrustation on the tube, arising from the use of impure water, will not add several pounds to the weight? And is it not also questionable whether the "perfect spherical fit and agreement be-

tween the valve and its seat" may not become so perfect as to be *fixed* by less heat than an ordinary fitting valve, from which some very small portion of steam is continually escaping?

Should my position be a fallacious one, I shall be most happy to withdraw my objection, and I trust that Mr. Nasmyth may be enabled to show that his "Absolute Safety Valve" is fully entitled to its appellation.

I am, &c.,

WILLIAM MORGAN.

Bromsgrove, June 2, 1851.

To the Editor of Appleton's Mechanics' Magazine.

While crossing Lake Erie in May last, my attention was attracted by a very conspicuous and well-defined sea mark, placed upon a rocky bar or shoal, some ten miles from the Canada shore, and towards the west end of the lake.

Upon inquiring of the master of the steamer Mayflower, I ascertained that the mark or signal in question had been erected by the party engaged in the survey of the lakes, under the direction of the Bureau of Topographical Engineers, and that it was considered by all the navigators of the lake an exceedingly useful beacon, as a means of warning off vessels approaching the dangerous reef upon which the signal was placed.

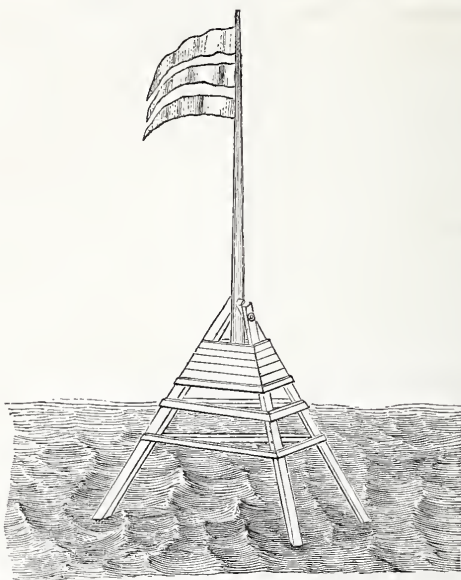
The whole thing appeared so simple in its construction, and so readily and cheaply put up, that it seemed to me worthy of a place in your useful journal. Accordingly, I asked a friend to procure a description of it from the officer who had planned and erected the beacon, namely, Captain John N. Macomb, of the Topographical Engineers, that I might place it at your disposal for publication, should you desire to present it to your readers. Accompanying the general description is a sketch of the beacon or tripod, as it appears when in place.

This, as you will perceive, furnishes an excellent signal for determining the position of shoals, rocks, &c., under water, and, as such, of great utility in carrying on marine or hydrographic surveys.

July 10, 1851.

N. B.—I think the beacon represented in the accompanying sketch stands in about six feet water.

Fig. 1.



Explanation of the Sketch.

Furnished by Capt. Macomb of the Topographical Engineers.

The tripods which I use consist of three main pieces of equal length, (generally thirty to forty feet), and of nine less pieces, used as ties or braces, firmly spiked in sets to the principal sticks. After placing the tripod upon a shoal, it is surmounted by a flag pole with a few flags of black, white, and red muslin; on the upper tier of braces a floor is laid, and the main pieces are *boxed* in just above that floor with a few pieces of board, as represented in the inclosed sketch; within the box thus formed about four hundred to a thousand pounds of stone are placed, according to the exposure of the reef to be marked, and when thus fitted up, I have found them to stand, and resist all the storms until the ice begins to run, when they must of course be cut down. A pyramid of this sort, with the addition of a little black paint and whitewash, forms a beautiful mark for the theodolite or sextant of the topographical engineer, and is only surpassed by the lighthouse itself for the purposes of the navigator. I happen to be in a field now where these marks are absolutely indispensable to the accurate

and thorough survey which is required. The three main pieces are put together by an iron bolt at the head, as they all lie in one plane upon the bow of the steamboat; the middle stick is then lifted so as to make the same angle with each of the others as they make between themselves, which is an angle of 60° , the braces are then put on, and the *skeleton* is carefully launched outwards to its place, by hauling in on running ropes passing through becketts at two of the feet, and lifting upon the head, to which there is a "guy" attached to prevent the third foot from striking too hard upon the bottom. The length of timber used should be so regulated as to bring the lower set of braces quite out of reach of the waves, and the thing is perfectly safe until the ice comes. I sometimes have these braces only six feet above the lake, sometimes twelve, according to exposure.

MECHANICS FOR THE MILLION.—NO V.

The Modulus of Machines.

The modulus* of a machine is the fraction which expresses the relation of the work done to the work applied.

* Professor Moseley first gave the general theory of the moduli of machines.

Thus if a machine should only perform one-half the work that is applied to it, then the modulus, in this case, would be $\frac{1}{2}$ or $\cdot 5$. However perfectly a machine may be constructed, there must always be a certain amount of work destroyed by the friction of the parts. The work that is thus destroyed depends upon the extent and nature of the rubbing surfaces. In many machines also, the power of the laboring agent may be exerted in a more or less efficient manner. Hence it is that the modulus of one machine sometimes differs from that of another. The following table of machines for the raising of water is taken from Morin's *Mécanique Pratique*.

	Modulus.
Incline chain pump, . . .	$\cdot 38$
Upright " . . .	$\cdot 53$
Bucket wheel, . . .	$\cdot 6$
Chinese wheel, . . .	$\cdot 58$
Archimedian screw, . . .	$\cdot 7$
Pumps for draining mines, &c.	$\cdot 66$

Ex. 1. If 2 H. P. be applied to a bucket wheel, how many cubic feet of water will be raised per hour to the height of 18 feet?

Work applied per hour $= 2 \times 33000 \times 60$.

Work done per hour $= 2 \times 33000 \times 60 \times \cdot 6$.

Work in raising 1 ft. of water $= 62.5 \times 18$.

$\therefore$ No. c. ft. $= \frac{2 \times 33000 \times 60 \times \cdot 6}{62.5 \times 18} = 2112$.

Ex. 2. If 5 H. P. be applied to a machine, lifting 3000 feet of water per hour to the height of 40 feet, what is the modulus of the machine?

Work applied per hour $= 5 \times 33000 \times 60$.

Work done per hour $= 3000 \times 62.5 \times 40$.

$\therefore$ Modulus $= \frac{\text{Work done}}{\text{Work applied}} = \cdot 75$.

Ex. 3. How many H. P. must an engine have to pump 7000 feet of water per hour, from a mine whose depth is 33 fathoms?

Work in raising the water per hour $= 7000 \times 62.5 \times 33 \times 6$.

Effective work of one H. P. per hour $= 33000 \times 60 \times \cdot 66$.

$\therefore$ H. P. $= \frac{7000 \times 62.5 \times 33 \times 6}{33000 \times 60 \times \cdot 66} = 66.2$.

Ex. 4. A cistern is 10 ft. long, 7 ft. broad, and 8 ft. deep. The height of the bottom of the cistern from the water in the well is 56 ft. In what time will a man pump the cistern full of water, allowing that he performs 2600 units of work per minute, and that the modulus of the pump is $\cdot 66$?

Wt. water in the cistern $= 35000$ lbs.

Ht. to which the centre of gravity of the water is raised $= \frac{8}{2} + 56 = 60$ ft.

$\therefore$ Work $= 35000 \times 60 = 2100000$.

The effective work of the man per h. $= 2600 \times 60 \times \cdot 66 = 102960$.

$\therefore$ No. hours $= \frac{2100000}{102960} = 20.4$ nearly.

Ex. 5. Required the same as in the last example, when the cistern is 7 ft. by 5 ft. and the depth 6 ft. and the height from the water in the well 37 ft.

Ans. 5.1 hours nearly.

Ex. 6. What work would the water in the cistern, of *Ex. 4*, perform upon a wheel, which takes up $\frac{2}{3}$ of the work?

Here wt. water $= 35000$ lbs.

Space through which the centre of gravity descends $= 4$ ft.

$\therefore$ Work $= 35000 \times 4 \times \frac{2}{3} = 56000$.

Ex. 7. In what time will a pumping engine of 4 horse powers fill a tank 15 ft. long, 10 ft. broad, and 6 ft. deep, from a well 20 sq. ft. in the section, supposing the level of the water in the well to be 40 ft. below the bottom of the tank, when the engine began to work, and that no water ran in during the process?

Wt. water raised $= 900 \times 62.5$.

Depth to which the water is depressed in the well $= \frac{900}{20} = 45$ ft.

Now the distance between the centres of gravity of the water in the tank and

that which is in the well is $+\frac{45}{5} + = \frac{9}{2} = 65.5$ ft.

$\therefore$ Work in pumping water $= 900 \times 62.5 \times 65.5 = 3684375$.

Effective work of the engine per min. $= 4 \times 33000 \times \cdot 66 = 87120$.

$$\therefore \text{No. min.} = \frac{3684375}{87120} = 42.2.$$

Ex. 8. Requiring the same as in the last example, when the tank is 12 ft. long, 9 ft. broad, and 8 ft. deep.

Ans. 40.6 min.

Laboring Forces.

We shall now consider, more in detail, some of the most important laboring forces. Besides the laboring force of animals, the intellect of man has subjugated the elements of nature to perform work;—the rolling stream and the water-fall have been made to move the water-wheel, in order to grind our corn;—the ocean, agitated by the attraction of distant spheres, does our work in its ceaseless ebb and flow, by carrying our ships and barges to and from our inland cities;—the air does our work, by pressing upon the sails of the windmill, and bearing vessels to our shores laden with the merchandise of distant lands;—fire and water do our work, in the form of steam,—an agent as various, as to the mode of its application, as it is exhaustless with respect to the power which it develops;—and the time may not be distant when even the most subtle and terrific agents of nature may be constrained to perform useful labor.

Work of a Water-wheel.

When water, or any body falls from a given height, the work which it is capable of performing, will be just that which would be done upon it in raising it to the height from which it has fallen. It is no matter in what way this work is used,—whether the water falls into the buckets of an overshot wheel, or delivers its work upon the paddles of an undershot wheel,—the laboring force of the water will always be equal to the work due to the height of the fall.

Ex. 1. The breadth of a stream is 4 feet, depth 3 feet, mean velocity of the water 15 feet per minute, and the height of the fall 20 feet; required the H. P. of the water-wheel which does $\frac{7}{10}$ of the work of the water, and also the number of bushels of corn which the wheel will grind in a day of 10 hours.

$$\text{Water going over the fall per min.} = 4 \times 3 \times 15 = 180 \text{ c. ft.}$$

$$\begin{array}{rcl} \text{Weight} & & \\ 180 \times 62.5 \text{ lbs.} & & \end{array}$$

As this water descends the height of 20 feet,

$$\text{The work of the water per min.} = 180 \times 62.5 \times 20.$$

But the wheel does $\frac{7}{10}$ of this work.

$$\therefore \text{Work wheel per min.} = 180 \times 62.5 \times 20 \times .7.$$

$$\text{And H.P.} = \frac{180 \times 62.5 \times 20 \times .7}{33000} = 4.77.$$

Now a horse power is able to grind 1 bushel of corn per hour.

$$\therefore \text{Number bushels per day} = 10 \times 4.77 = 47.7.$$

Ex. 2. Required the same as in the last example, when the breadth of the stream = 3 ft., depth = 2 ft., and velocity = 12 ft. *Ans.* H. P. = 1.9, and 19 bush.

Ex. 3. The section of a stream is 4 feet by 2 feet, the mean velocity is 20 feet per minute, and the height of the fall 15; what will be the H. P. of the water-wheel whose modulus is .68, and how many cubic feet of water per min. will the wheel pump from the bottom of the fall to the height of 115 feet?

Content water going over the fall per min. = $4 \times 2 \times 20 = 160$ c. ft.

Weight of do., 160×62.5 lbs.

$$\text{Work of the wheel per min.} = 160 \times 62.5 \times 15 \times .68.$$

$$\text{And H.P.} = \frac{160 \times 62.5 \times 15 \times .68}{33000} = 3.09.$$

Work in pumping 1 c. ft. of water = 62.5×115 .

$$\therefore \text{Number feet pumped per min.} = \frac{160 \times 62.5 \times 15 \times .68}{62.5 \times 115} = 14.2.$$

Ex. 4. How many cubic feet of water per minute will the wheel, in the last example, pump from the top of the fall to the elevation there mentioned?

In this case, only a portion of the water of the stream goes upon the wheel.

Space through which the water is pumped = $115 - 15 = 100$ ft.

$$\text{Work in pumping 1 c. ft.} = 62.5 \times 100.$$

Work of 1 c. ft. water going on the wheel = $62.5 \times 15 \times .68$.

$$\therefore \text{Number ft. going on the wheel to pump 1 ft.} = \frac{62.5 \times 100}{62.5 \times 15 \times .68} = 9.8.$$

Hence, in order to pump 1 ft. there

must be 9.8 c. ft. fall upon the wheel, or it takes 10.8 feet of the stream to pump 1 ft., therefore the water pumped is just $\frac{1}{10.8}$ part of the whole. Now the whole water=160 ft. per minute.

$\therefore$ Water pumped per min.= $\frac{160}{10.8}=14.8$ c. ft.

Hence it appears that it would be more advantageous to pump water from the top of the fall.

Or thus,

Let x =no. c. ft. of water pumped per min.

No. c. ft. water going over the fall= $160-x$.

$\therefore$ Work of the wheel per min.= $(160-x) 62.5 \times 15 \times .68$.

Work in pumping water per min.= $x \times 62.5 \times 100$.

But as all the work done upon the wheel goes to pump the water, we have,
 $x \times 62.5 \times 100 = (160-x) 62.5 \times 15 \times .68$.

$\therefore x=14.8$ c. ft.

Ex. 5. How many cubic feet of water will the wheel in *Ex. 1* raise per minute, from the top of the fall to the height of 40 feet above that point? *Ans.* 46.6.

Ex. 6. How many cubic feet of water would be required per minute to drive a water wheel of 4 effective horse powers, supposing the height of the fall to be 16 feet, and the modulus of the wheel .68?

Work of the wheel per min.=33000 $\times 4$.

Effective work of 1 c. ft. of water= $62.5 \times 16 \times .68$.

Now, as many times as this work of 1 c. ft. can be taken out of the work of the wheel per minute, so many feet of water must go over the fall per minute.

$\therefore$ Number feet water= $\frac{33000 \times 4}{62.5 \times 16 \times .68} = 194.1$.

Or thus. Let x =no. c. ft. of water.

Work of the wheel per min.= $x \times 62.5 \times 16 \times .68$.

But this work must be equivalent to 4 horse powers,

$\therefore x \times 62.5 \times 16 \times .68 = 33000 \times 4$,

$\therefore x = \frac{33000 \times 4}{62.5 \times 16 \times .68} = 194.1$.

Ex. 7. Required the same as in the last example, when the H. P.=2, and the height of the fall=20 feet. *Ans.* 77.6.

Ex. 8. What must be the fall of the stream in *Ex. 3*, so that the wheel may perform the work of 3 horses?

Ans. 14.5 ft.

Work of the Hydraulic Ram.

18. From the experiments of Eytelwein, a celebrated German mathematician, it appears that the modulus of a hydraulic ram of the best construction is .87.

Ex. 1. In a hydraulic ram there are 14 gallons of water spent per minute, the fall of the water is 10 feet, it is required to determine the number of cubic feet of water which will be raised per minute to the height of 30 feet.

Weight water spent per min.=140 lbs.

$\therefore$ Work applied per min.= $140 \times 10 = 1400$.

$\therefore$ Work done per min.= $1400 \times .87$.

Work in raising 1 ft. of water= 62.5×30 .

$\therefore$ No. ft. water= $\frac{1400 \times .87}{62.5 \times 30} = 65$.

Ex. 2. Required the same as in the last example, when the water spent=11 gallons, and the fall=9 ft. *Ans.* 46.

Work of the Sun performed by Evaporation.

19. The heat of the sun is continually raising water into the atmosphere by evaporation. The vapor that is thus raised forms clouds at considerable elevations above the earth's surface; the rain, therefore, that falls from these clouds may be taken as the measure of the work of evaporation. In the torrid zone, the annual fall of rain, at a medium, is about 105 inches, while in the extreme parts of the north temperate zone it is not more than 15 inches. The mean of these quantities will be 5 feet, which may be presumed to be about the mean depth of the rain falling upon the whole of the earth's surface. Now, if we suppose 1000 feet to be the mean height from which rain falls, we have,

The work upon 1 mile in H. P.=
 $\frac{27378400 \times 5 \times 62.5 \times 1000}{365 \times 24 \times 60 \times 33000} = 502$.

$\therefore$ Work on the whole of the earth's surface = 502 H. P. $\times 197000000 = 98894000000$ H. P.

Results of Experiments on Foreign Bituminous Coals, and on Coals of a similar constitution from the Navy Yard.

NAME.	Proportion of grate to heating surface.	Pounds of coal consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended on the products of combustion, ascertained by comparing total calculated evaporative power of unit of fuel with evaporative power ascertained by experiment.	EVAPORATION.			DENSITY.				
					Cubic inches of water evaporated from initial temperature by one pound of fuel per hour.	Cubic inches of water evaporated from initial temperature by one pound of fuel per hour.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.
Foreign Coals.												
Pictou.....	1 to 26·83	7·81	232·55	14 93	200·31	85·54	8·41	1·32	53·55	38·56	43·12	....
Sidney.....	" "	8·31	....	20·05	204·64	63·40	7·99	1·34	47·44	52·42	40·12	3·96
Pictou (Cunard's).....	" "	9·84	....	....	205·63	75·46	8·49	1·33	49·25	39·01	38·00	3·82
Liverpool.....	" "	8·58	251·06	17·70	190·98	61·49	7·84	1·26	47·88	53·70	40·12	3·92
Newcastle.....	" "	8·03	....	....	210·17	62·96	8·66	1·26	50·82	51·11	38·25	3·70
Scotch.....	" "	10·74	235·73	16·14	163·60	66·19	6·95	1·52	51·09	47·94	39·87	8·65
Average.....	1 to 26·83	8·89	239·78	17·20	195·89	64·67	8·06	1·34	50·00	47·12	39·91	4·81
West of Alleghany Mountain's Coal.												
Pittsburg*.....	1 to 26·83	....	....	....	....	48·33	8·20	1·25	46·81	....	....	....
Cannelton.....	" "	11·09	208·26	18·23	166·62	68·83	7·34	1·27	47·65	55·79	28·28	3·25
Average.....	1 to 26·83	11·09	208·26	18·23	166·62	58·65	7·77	1·26	47·23	55·79	28·28	3·25

* The experiments upon the Pittsburg coal were incomplete, owing to too small a sample being experimented on.

GENERAL CHARACTERS.—The exterior of the foreign bituminous coals and those of similar constitution from West of the Alleghany Mountains, presents a resinous lustre. They have great facility of ignition and a high degree of activity in the combustion of their volatile constituents. Their coke intumesces strongly.

LOCATION OF THE COAL.—Of the foreign coals, those from "Pictou" and "Sidney" were from places of that name in Nova Scotia. The "Liverpool" and "Newcastle" were from near those towns in England; and the "Scotch" was from Scotland.

Of the coals from West of the Alleghany Mountains, the "Pittsburg" was from Pittsburg, Pennsylvania; and the "Cannelton" was from Cannelton, Indiana.

ACTION IN THE FURNACE.—The "Pictou" was easily ignited, its clinker was in sheets of considerable magnitude, and somewhat porous. The "Sidney" burnt with a large and smoky flame, its coke falls into small fragments, and wastes between the grate bars. Its clinker black, compact, and in thin sheets; highly fusible, spreading over and adhering to grate bar

JOHNSON'S EXPERIMENTS ON COALS.

and Engineers' Journal.]

B. F. ISHERWOOD, IN AUGUST NUMBER OF MAGAZINE.

on, West of the Alleghany Mountains. By Prof. W. R. JOHNSON. Made at the U. S. Washington.

WASTE.			CONSTITUENTS OF COAL.					TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.			
Per cent. of water, steam, smoke, clinker, &c.	Per cent. of clinker alone.	Per cent. of soot alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air entering below ash pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.				
3.37	6.13	0.47	2.567	27.063	0.769	13.389	56.981	91°	83°	309°	63	11.00	23	24	1.267	10.737	9.078	50.185
6.01	2.25	0.39	3.125	23.810	....	5.495	67.570	75	63	314	"	11.50	"	"	....	....	....	....
2.06	6.19	0.44	0.781	25.795	....	12.508	60.735	64	69	312	"	11.25	"	"	....	....	....	....
5.04	1.86	0.48	0.892	39.587	0.376	4.622	54.899	87	81	324	"	11.50	"	"	1.143	11.205	9.238	79.557
5.63	3.14	0.40	2.007	55.597	0.230	5.400	56.996	84	81	354	"	12.30	"	"	....	....	....	....
0.10	5.63	0.63	3.013	38.837	0.358	9.338	48.812	81	77	314	"	11.46	"	"	0.853	11.219	11.542	77.239
8.71	4.20	0.47	2.064	35.115	0.433	8.459	57.665	80	76	321	63	11.67	23	24	1.088	11.054	9.953	78.994
8.25	0.941	0.84	1.40	36.603	0.160	7.074	54.926	50	40	265	63	12.25	23	24	....	....	....	....
5.13	1.636	0.58	2.60	33.992	....	4.974	58.437	49	43	307	"	13.30	"	"	1.205	13.207	5.510	81.283
6.69	1.29	0.71	2.00	35.300	0.160	6.024	56.682	50	42	286	63	12.78	23	24	1.205	13.207	5.510	81.283

heating them, &c. The coal ignites promptly, and burns rapidly, agglutinating and swelling but slightly. The "Pietou (Cunard's)" burnt promptly with a long smoky flame; its clinker was black, vitreous, and porous; tolerably friable, and not apparently inclined to adhere to grate. The "Liverpool" burnt with a long smoky flame, swelling up and cementing into a spongy mass, leaving a like porous coke; its clinker was compact and vitrified, but not in large masses. The "Newcastle" brought into a pasty state during coking, and portions of gas temporarily confined within the semi-fluid mass burst through with smart explosions; its clinker was highly fusible, and adhered to grate; it vitrified into black, compact masses. The "Scotch" ignited promptly, and gave a dense flame, with a heavy smoke, but did not swell nor agglutinate much in coking; its clinkers were of considerable magnitude, obstructing the grate.

The "Cannelton" coal burns with but little intumescence, and does not agglutinate; it allows a free passage to the air, and gives a brilliant, but not durable flame: it ignites easily, and has but little tendency to soil, and does not crumble into powder by transportation. Its clinker is friable, easily broken, and has but little tendency to adhere to grate.

The use of the air-plate, on an average, increased the evaporative power for the six foreign and one American coal 3.38 per cent., but decreased the bulk of water evaporated in a given time 5.37 per cent.

Results of Experiments on Artificial Coke—on Natural Coke—on Mixed Bituminous and U. S. Navy Yard

NAME.	Proportion of grate to heating surface.	Pounds of fuel consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended on the products of combustion, ascertained by comparing total calculated evaporative power of unit of fuel with evaporative power ascertained by experiment.	EVAPORATION.			DENSITY.				
					Cubic inches of water evaporated from initial temperature by one pound of fuel per hour.	Cubic inches of water evaporated from final temperature by one pound of fuel per hour.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.
Artificial Coke of Midlothian Coal (Va.).....	1 to 26·83	9·64	188·92	12·15	210·21	75·57	8·63	....	32·70	....	....	....
Artificial Coke of Cumberland Coal (Md.), Neff's..	" "	8·43	....	....	217·35	65·81	9·00	....	31·57	....	....	....
Average.....	1 to 26·83	9·04	188·92	12·15	213·78	70·69	8·82	....	32·14	....	....	....
Natural Coke (Tuckahoe, Va.).....	1 to 26·83	8·15	257·27	14·68	189·18	57·51	8·47	1·32	46·64	56·98	38·25	22·4
Mixture — 1-5th Midlothian bituminous and 4-5th Beaver Meadow Anthracite.....	1 to 23·23	5·83	....	....	215·69	46·04	8·86	....	51·29	....	....	....
Mixture—1-5th Cumberland bituminous and 4-5th Beaver Meadow Anthracite.....	" "	7·98	....	....	182·36	58·67	9·18	....	54·51	....	....	....
Average.....	1 to 23·23	6·90	....	....	199·02	52·35	9·02	....	52·90	....	....	....
Dry Pine Wood (ordinary kind).....	1 to 26·83	15·87	281·52	37·20	107·00	63·46	4·69	....	21·01	....	....	....

REMARKS ON THE MIXED COALS.—In the mixture of the Midlothian and Beaver Meadow coals, the use of the bituminous coal does not seem to have greatly accelerated the action of the anthracite; that is, did not bring the boiler to steady action in quicker time than the anthracite alone.

In the mixture of the Cumberland and Beaver coals, the use of the bituminous coal considerably accelerated the action of the anthracite. It also appears that mixing coal of 1 bituminousness with the anthracite increases considerably the activity of the fire, with an augmentation of the total evaporative power.

REMARKS ON THE NATURAL COKE.—The natural coke from Tuckahoe, Virginia, has a high proportion of sulphur; when fully ignited it throws out an intense heat, accompanied

anthracite Coals, and on Dry Pine Wood. By Prof. W. R. JOHNSON. Made at the Washington.

WASTE.			CONSTITUENTS OF COAL.						TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.			
Per cent. of waste, mainly clinkers, soot, &c.	Per cent. of clinker alone.	Per cent. of soot alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air entering below ash pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.	Grams of water from 100 cubic inches of gas.	Carbonic acid.	Oxygen.	Nitrogen.	
5.55	10.51	....	....	....	....	16.545	....	47°	41°	301°	63	12.84	23	24	0.56	13.357	7.943	78.700	
3.34	3.55	....	....	....	....	13.340	....	75	62	277	63	12.60	"	"	....	....	....	....	
5.00	7.03	....	....	....	....	14.943	....	61	52	259	63	12.72	23	24	0.56	13.357	7.943	78.700	
8.46	5.31	0.27	1.116	11.977	0.466	11.826	75.081	77	75	268	63	10.99	23	24	0.90	9.051	13.787	77.162	
8.39	4.91	....	....	....	....	....	....	59	55	271	41	9.90	20	21	....	....	....	....	
8.18	3.09	....	....	....	....	....	....	57	55	289	....	10.70	....	....	....	....	....	....	
3.53	4.00	....	....	....	....	....	....	58	55	280	41	10.30	20	21	....	....	....	....	
3.07	....	....	3.67	....	....	0.307	....	68	53	315	63	12.25	23	24	1.97	9.21	10.213	80.577	

blue flame: during combustion it gives out oppressive sulphurous fumes. Its clinker preads into sheets, but does not materially obstruct the grates.

REMARKS ON THE DRY PINE WOOD.—The pine wood used in the experiment was dry, and thoroughly seasoned; it was of the ordinary white pine kind (not pitch), and a "cord" of 128 cubic feet weighed 2689.20 pounds.

Summary of the Results of Experiments on Coals. By Prof. W. I.

NAME.	Proportion of grates to heating surface.	Pounds of fuel consumed per hour on each square foot of grate.	Bulk in cubic feet of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Per cent. of evaporative power expended in producing the steam, obtained by comparing total calculated evaporative power of unit of fuel with evaporative power ascertained by experiment.	EVAPORATION.			DENSITY.				
					Cubic inches of water evaporated from initial temperatures by one pound of fuel per hour.	Cubic inches of water evaporated from initial temperatures by one pound of fuel per hour.	Pounds of water evaporated from a temperature of 212° F. by one pound of fuel.	Spec. grav.	Weight of a cubic foot of fuel in pounds in a merchantable state.	Weight of a cubic foot of ashes in pounds.	Weight of a cubic foot of clinker in pounds.	Weight of a cubic foot of soot in pounds.
Pennsylvania Anthracite .	1 to 26-00	6-43	340-42	14-58	223-00	55-12	9-59	1-50	53-35	50-85	35-70	22-0
Do. Bituminous .	" 26-23	6-77	258-82	13-29	223-21	60-18	9-32	1-36	52-55	42-52	32-26	12-1
Maryland do. .	" 26-83	7-11	237-21	14-86	242-67	64-99	9-93	1-34	53-11	36-30	34-22	17-8
Virginia do. .	" 25-93	7-42	288-70	18-11	199-62	57-03	8-43	1-34	48-76	51-23	38-75	12-4
Foreign do. .	" 26-83	8-89	239-78	17-20	195-89	64-67	8-06	1-34	50-00	47-12	39-91	4-8
W. of Alleghany Moun. do.	" 26-83	11-09	208-26	18-23	166-62	58-65	7-77	1-26	47-23	55-79	28-26	3-2
Artificial Coke .	" 26-83	9-04	188-92	12-15	213-78	70-69	8-82	....	32-14	....	....	....
Natural do. .	" 26-83	8-15	257-27	14-68	189-18	57-51	8-47	1-32	46-64	56-98	38-25	22-6
Mixed Coal, in the proportion of 4 of anthracite to 1 of bituminous .	" 23-23	6-90	....	....	199-02	52-35	9-02	....	52-90	....	....	....
Dry Pine Wood .	" 26-83	15-87	281-52	37-20	107-00	63-46	4-69	....	21-01	....	....	3-2

Comparison of those Properties of Coals which qualify their value as Fuel for Marine Steamers.

NAME.	Bulk of atmospheric air at standard temperature, and pressure required for the combustion of one pound of fuel.	Evaporative power by unit of weight.	Weight by experiment when in a merchantable state—unit of bulk.	Total waste ashes, clinker, soot, &c.; unit of bulk.	Waste of clinker alone—unit of bulk.	Waste of soot alone—unit of bulk.	Sulphur—unit of bulk.	Space required for stowing one ton—cubic feet.
Pennsylvania Anthracite .	1-000	1-000	1-000	1-000	1-000	1-000	1-000	42-1
Do. Bituminous .	0-760	0-972	0-985	1-173	1-890	3-555	13-889	42-1
Maryland do. .	0-697	1-041	0-995	1-146	2-013	4-333	....	42-1
Virginia do. .	0-818	0-884	0-914	1-263	3-020	7-666	20-961	45-7
Foreign do. .	0-704	0-840	0-937	1-004	2-561	5-222	8-327	44-1
West of Alleghany Mountain's Bituminous .	0-612	0-809	0-885	0-772	0-786	7-889	3-077	47-1
Artificial Coke .	0-554	0-920	0-602	1-730	4-286	....	....	69-1
Natural do. .	0-755	0-882	0-874	2-129	3-238	3-000	8-961	48-1
Mixed Coal, in the proportion of 4 of anthracite to 1 of bituminous .	....	0-940	0-992	0-984	2-439	....	....	41-1
Dry Pine Wood .	0-827	0-489	0-393	0-005	....	....	....	106-1

JOHNSON. *Made at the U. S. Navy Yard, Washington. 1842-43.*

WASTE.	CONSTITUENTS OF COAL.						TEMPERATURE.			DRAUGHT.				Relation of the chief products of combustion ascertained by analysis of gases from flue.				
	Per cent. of clinker alone.	Per cent. of ash alone.	Per cent. of moisture.	Per cent. of volatile matter other than moisture.	Per cent. of sulphur.	Per cent. of earthy matter.	Per cent. of fixed carbon.	Of air entering below ash-pit.	Of feed water.	Of gases entering smoke chimney.	Height of smoke chimney in feet.	Velocity of gases in smoke chimney in feet per second.	Square inches of smoke chimney area to one square foot of grate.	Square inches of flue at bridge to one square foot of grate.	Grains of water from 100 cubic inches of gas.	Carbonic acid.	Oxygen.	Nitrogen.
7	1.64	0.09	1.190	3.980	0.052	6.51	88.54	78°	70°	27.30	58	11.18	224	234	0.810	8.977	12.541	78.482
17	3.10	0.32	1.170	16.030	0.722	10.13	72.47	72	68	282	53	10.67	224	234	0.895	10.000	10.547	79.453
4	3.30	0.39	1.250	14.200	.....	9.49	75.05	81	71	305	63	11.92	23	24	1.360	11.282	10.166	78.552
15	4.95	0.69	1.620	29.500	1.090	10.58	58.30	70	66	316	54	10.96	224	234	0.882	9.582	10.843	79.574
1	4.20	0.47	2.064	35.115	0.433	8.459	57.665	80	76	321	63	11.67	23	24	1.088	11.054	9.953	78.995
19	1.29	0.71	2.000	35.300	0.160	6.024	56.682	50	42	286	63	12.78	23	24	1.205	13.207	5.510	81.283
10	7.03	.....	.....	.....	.....	14.943	.....	61	52	289	63	12.72	23	24	0.560	13.357	7.943	78.700
16	5.31	0.27	1.116	11.977	0.466	11.826	75.081	77	75	268	63	10.99	23	24	0.900	9.051	13.787	77.162
3	4.00	.....	.....	.....	.....	.....	.....	58	55	280	41	10.30	20	21	.....	.....	.....	.....
37			3.670			0.307		68	53	315	63	12.25	23	24	1.970	9.210	10.213	80.577

ON STEAM-BOILERS AND THE CAUSES OF THEIR EXPLOSION.

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The following is an abstract of two lectures delivered by Mr. Fairbairn, on the 23d and 24th of April, at Leeds. We will not hazard the opinion that the subject matter of this paper of Mr. Fairbairn's is not well understood by our engineers; but certain it is, that however well-informed they may be in principle, there is too frequently a total disregard of it manifested in practice; and the public, looking to acts of legislation for their protection, shut their eyes to the dangers they daily incur by employing an ignorant set of men in positions where, of all others, intelligence, sound sense, and judgment are required.

The inspection of *boilers* by Commissioners, is a grave farce. We will ven-

ture to say, that the same amount of inspection held on the *engine-men*, would be productive of much more good; and until some such provision be made, we must continue to run the risks we have done, only too well content if we ourselves escape.

We do not entirely agree with Mr. Fairbairn in all his positions as to the causes of explosion, but we most heartily concur with him in the measures necessary to be taken for their prevention, and offer no apology for occupying so much space in the present number with the subject.

I propose to consider the boiler in its *construction, management, security and economy.*

1st. As to the construction. Here I shall have to go a little into detail, in order to show, in construction, the absolute necessity there exists for adhering to form and other considerations, essential in the practice of mechanical engineers, in effecting the maximum of strength with the minimum of material. In boilers this is the more important, as any increase in the thickness of the plates obstructs the transmission of heat, and exposes the rivets as well as the plates to injury on the side exposed to the action of the furnace.

It has generally been supposed that the rolling of boiler plate iron gives to the sheets greater tenacity in the direction of their length than in that of their breadth: this is, however, not correct; as a series of experiments which I made some years since fully proves that there is no difference in the tensile strength of boiler plates when torn asunder in the direction of the fibre or across it. From five different sorts of iron, the following results were obtained.

Description of iron.	Mean breaking weight in tons in the direction of the fibre.	Mean breaking weight in tons across the fibre.
Yorkshire Plates,	25·77	27·49
Yorkshire Plates,	22·76	26·37
Derbyshire Plates,	21·68	18·65
Shropshire Plates,	22·82	22·00
Staffordshire Plates,	19·56	21·01
Mean, -	22·51	23·10

From this it appears that we may safely use iron plates in the construction of boilers, in whatever direction may best suit the convenience of the maker. Next to the tenacity of the plates comes the question of riveting, or the best and surest means of securing them together. On this part of the subject we have been widely astray, and it required some skill and no inconsiderable attention in conducting the experiments, to convince the unreflecting portion of the public—and even some of our boiler-makers—that the riveted joints were not stronger than the plate itself. At first sight this would appear to be the case, but a moment's reflection will soon convince us to the contrary, as in punching holes along the edge of a plate, it is obvious that the plate must be weakened to the extent of the sectional areas punched out, and that it is next to impossible, under the cir-

cumstances, to retain the same strength in the material, after such diminution has been effected, as existed in the previously solid plate. This was clearly demonstrated by a series of experiments which took place some years since, and in which the strength of almost every description of riveted joint was determined by tearing them directly asunder. The results obtained from these experiments were conclusive, as regards the relative strength of riveted joints and the solid plates. In two different kinds of joints—double and single riveted—the strengths were found to be, in the ratio of the plate, as the numbers 100, 70, and 56.

Assuming the strength of the plate to be, - - - - - 100
 The strength of a double riveted joint would be, after allowing for the adhesion of the surfaces of the plate, - - - - - 70
 And the strength of a single riveted joint, - - - - - 56

These proportions of the relative strengths of plates and joints may therefore in practice be safely taken as the standard value, in the construction of vessels required to be steam and water tight, and subjected to pressure varying from 10 lbs. to 100 lbs. on the square inch.

In the construction of boilers exposed to severe internal pressure, it is desirable to establish such forms, and so to dispose the material as to apply the greatest strength in the direction of the greatest strain; and in order to accomplish this, it will be necessary to consider whether the same arrangement be required for all diameters, or whether the form as well as the disposition should not be changed. To determine these questions in cylindrical boilers, recourse must be had to experiment, or such deduction as may apply to any given case, and such as is founded upon unerring data derived from experimental research. On this head I am fortunate in having before me the calculations of Professor Johnson, of the Franklin Institute of America, whose inquiries into the strength of cylindrical boilers are of great value, and from which the following short abstract may be useful.

“1st. To know the force which tends to burst a cylindrical vessel in the longi-

tangential direction, or, in other words, to separate the *head* from the curved *sides*, we have only to consider the actual area of the head, and to multiply the units of *surface* by the number of units of *force* applied to each superficial unit. This will give the total *divellent* force in that direction.

"To counteract this, we have, or may be conceived to have, as many longitudinal bars as there are lineal units in the circumference of the cylinder. The united strength of these bars constitutes the total retaining or *quiescent* force, and at the moment when rupture is about to take place, the *divellent* and the *quiescent* forces must obviously be equal.

"2d. To ascertain the amount of force which tends to rupture the cylinder along the curved side, or rather along the opposite sides, we may regard the pressure as applied through the whole breadth of the cylinder, upon each lineal unit of the diameter. Hence the total amount of force which would tend to divide the cylinder in halves, by separating it along two lines on opposite sides, would be represented by multiplying the diameter by the force exerted on each unit of surface, and this product by the length of the cylinder. But even without regarding the length, we may consider the force requisite to rupture a *single band*, in the direction now supposed, and of one lineal unit in breadth; since it obviously makes no difference whether the cylinder be long or short, in respect to the ease or difficulty of separating the sides. The *divellent* force in this direction is therefore truly represented by the diameter multiplied by the pressure per unit of surface. The retaining or *quiescent* force in the same direction is only the strength or tenacity of the two opposite sides of the supposed band. Here also, at the moment when a rupture is about to occur, the *divellent* force must exactly equal the *quiescent* force."

Mr. Johnson then goes on to show that as the diameter is increased, the product of the diameter and the force or pressure per unit of surface is increased in the same ratio. This truism I shall endeavor to prove; as also, that as the diameter of any cylindrical vessel is increased, the thickness of the metal must also be increased in the exact ratio of the increase of the diameter, the pressure,

or, as Mr. Johnson calls it, the *divellent* force being the same; when the diameter of a boiler is increased, it must be borne in mind that the area of the ends is also increased, not in the ratio of the diameter, but in the ratio of the square of the diameter, and it will be seen that instead of the force being doubled, as is the case in the direction of the diameter and circumference, it is quadrupled upon the ends, or what is the same thing, a cylinder double the diameter of another cylinder, has to sustain four times the pressure in the longitudinal direction.

The retaining force, or the thickness of the metal of a cylindrical boiler does not, however, increase in the same ratio as the area of the circle, but simply in the ratio of the diameter; consequently the thickness of the metal will require to be increased in the same ratio as the diameter is increased. From this it appears that the tendency to rupture by blowing out the ends of a cylindrical boiler, will not be greater in this direction than it is in any other direction; we may therefore safely conclude, since we have seen that the tendency to rupture increases in both directions in the ratio of the diameter, that any deviation from that law, as regards the thickness of the plates, would not increase the strength of the boiler.

I have been led to these inquiries from the circumstance that Mr. Johnson appears to reason on the supposition that there are no joints in the plates, and that the tenacity of the iron is equal to 60,000 lbs., rather more than 26 tons to the square inch. Now we have shown by the results of the experiments already adduced, that ordinary boiler plates will not bear more than 23 tons to the square inch, and as nearly one-third of the material is punched out for the reception of the rivets, we must still further reduce the strength, and take 15 tons or about 34,000 lbs.* on the square inch, as the tenacity of the material, or the pressure at which a boiler would burst.

This I should consider in practice as the maximum power of resistance of

* By experiment it is found that the strength of the riveted joints of boilers is only about one-half the strength of the plate itself; but taking into consideration the crossing of the joints, 34,000 lbs. may reasonably be taken as the tenacity of the riveted plates, or the bursting pressure of a cylindrical boiler.

boiler plates in their riveted state, and I will now trouble you to follow me in a concise and I trust not uninteresting investigation as to the bearing powers of boilers, and the pressure at which they can be worked with safety.

It has been stated that the strengths of cylindrical boilers, when taken in the direction of their circumference, are in the ratio of their diameters, and when taken in the direction of the ends, as the squares of the diameters, a proposition which it will not be difficult to demonstrate as applicable to every description of boiler of the cylindrical form. It will be seen, however, that the strain is not exactly the same in every direction, and that there is actually less upon the material in the longitudinal direction, than there is upon the circumference. For example, let us take two boilers, one three feet diameter and the other six feet, and suppose each to be subject to a pressure of 40 lbs. to the square inch. In this condition, it is evident that the area or number of square inches in the end of a three-foot boiler is, to that of the area of the six-foot boiler, as 1 to 4, and by a common process of arithmetic it will be found that the edges of the plates forming the cylindrical part of the three-foot boiler is subject (at 40 lbs. on the square inch) to a pressure of 40,712 lbs.—upwards of 18 tons—whereas the plates of the six-foot boiler have to sustain a pressure of 162,848 lbs., or 72 tons, which is quadruple the force to which the boiler, only one-half the diameter, is exposed; and the circumferences being only as two to one, there is necessarily double the strain upon the cylindrical plates of the large boiler. Now this is not the case with the other parts of the boiler, as the circumference of a cylinder increases only in the ratio of the diameter, consequently the pressure, instead of being increased in the ratio of the squares of the diameter, as shown in the ends, is only doubled, the circumference of the six-foot boiler being twice that of the three-foot boiler.

Let us, for the sake of illustration, suppose the two cylindrical boilers, such as we have described, to be divided into a series of hoops of one inch in width; and, taking one of these hoops in the three-foot boiler, we shall find it exposed at a pressure of 40 lbs. on the square

inch, to a force of 1,440 lbs., acting on each side of a line drawn through the axis of a cylinder 36 inches diameter and 1 inch in depth, and which line forms the diameter of the circle. Now this force causes a strain upon any two points in the three-foot circle of 720 lbs., and, assuming the pressure to be increased till the force becomes equal to the tenacity or retaining powers of the iron, it is evident, in this state of the equilibrium of the two forces, that the least preponderance on the side of the internal pressure would insure fracture. And, suppose we take the plates of which the boiler is composed at one quarter of an inch thick, and the ultimate strength at 34,000 lbs. on the square inch,

we shall have $\frac{34,000}{36 \times 2} = 472$ lbs. per square inch as the bursting pressure of the boiler. Again, as the forces in this direction are not as the squares, but simply as the diameter, it is clear that at 40 lbs. on the square inch, we have, in a hoop an inch in depth, or that portion of a cylinder whose diameter is 6 feet, exactly double the force applied, as was acting in the diameter of 3 feet. Now, assuming the plates to be a quarter of an inch thick, as in the three-foot boiler, it follows, if the forces at the same pressure be doubled in the large cylinder, that the thickness of the plates must also be doubled in order to sustain the same pressure with equal security; or, what is the same thing, the six-foot boiler must be worked at half the pressure, in order to insure the same degree of safety as attained in the three-foot boiler at double the pressure. From these facts, it may be useful to know that boilers having increased dimensions should also have increased strength in the ratio of their diameter; or, in other words, the plates of a six-foot boiler should be double the thickness of the plates of a three-foot boiler, and so on in proportion as the diameter is increased.

The relative powers of force applied to cylinders of different diameters become more strikingly apparent when we reduce them to their equivalents of strain per square inch, as applied to the ends and circumference of the boiler respectively. In the three-foot boiler, working at 40 lbs. pressure, we have a force equal to 720 lbs. upon an inch width of plate, and one

quarter of an inch thick, or 720 by 4 equal 2880 lbs., the force per square inch upon every point of the circumference of the boiler.

Let us now compare this with the actual strength of the riveted plates themselves, which, taken as before at 34,000 lbs. on the square inch, we arrive at the ratio of pressure as applied to the strength of the circumference, as 2880 to 34,000, nearly as 1 to 12, or 472 per square inch, as the ultimate strength of the riveted plates.

These deductions appear to be true in every case as regards the resisting powers of cylindrical boilers, to a force radiating in every direction from its axis towards the circumference; but the same reasoning is, however, not maintained when applied to the ends, or, to speak technically, to the angle iron and riveting where the ends are attached to the circumference. Now, to prove this, let us take the three-foot boiler, where we have 113 inches in the circumference, and upon this circular line of connection we have, at 40 lbs. to the square inch, to sustain a pressure of 18 tons, which is equal to a strain of 360 lbs. acting longitudinally upon every inch of the circumference. Apply the same force to a six-foot boiler, with a circumference or line of connection equal to 226 inches, and we shall find it exposed to exactly four times the force, or 72 tons; but in this case it must be borne in mind that the circumference is doubled, and consequently the strain, instead of being in the quadruple ratio, is only doubled, or a force equal to 720 lbs. acting longitudinally, as before, upon every inch of the circumference of the boiler. From these facts we come to the conclusion that the strength of cylindrical boilers is in the ratio of their diameters, if taken in the line of curvature, and as the squares of the diameters as applied to the ends or their sectional area; and that all descriptions of cylindrical tubes, to bear the same pressure, must be increased in strength in the direction of their circumference simply as their diameters, and in the direction of the ends as the squares of the diameters.

Again, if we refer to the comparative merits of the plates composing cylindrical vessels subjected to internal pressure, they will be found in this anomalous condition, that the strength in their lon-

gitudinal direction is twice that of the plates in the curvilinear direction. This appears by a comparison of the two forces, wherein we have shown that the ends of the three-foot boiler, at 40 lbs. internal pressure, sustain 360 lbs. of longitudinal strain upon each inch of a plate a quarter of an inch thick, whereas the same thickness of plates have to bear in the curvilinear direction a strain of 720 lbs. This difference of strain is a difficulty not easily overcome, and all that we can accomplish in this case will be to exercise a sound judgment in crossing the joints, the quality of the workmanship, and the distribution of the material. For the attainment of these objects, the following table, which exhibits the proportionate strength of cylindrical boilers from 3 to 8 feet in diameter, may be useful.

TABLE of equal strengths in Cylindrical Boilers from 3 to 8 feet diameter, showing the thickness of metal in each respectively, at a pressure of 450 lbs. to the square inch:—

Diameter of Boilers.		Bursting pressure — equivalent to the ultimate strength of the riveted joint—as deduced from experiment. 34,000 lbs. to the square inch.	Thickness of the plates in decimal parts of an inch.
Feet	Inches	450 lbs.	
3	0		·250
3	6		·291
4	0		·333
4	6		·376
5	0		·416
5	6		·458
6	0		·500
6	6		·541
7	0		·583
7	6		·625
8	0		·666

Boilers of the simple form, and without internal flues, are subjected only to one species of strain, but those constructed with internal flues are exposed to the same tensile force which pervades the simple form, and further, to the force of compression which tends to collapse, or crush the material of the internal flues. In the cylindrical boiler, with round flues, the forces are diverging from the central axis as regards the outer shell, and converging as ap-

plied to every separate flue which the boiler contains.

These two forces in a steam boiler are in constant operation; the tendency of the one being to tear up the external plates and force out the ends, and the other to destroy the form and to force the material into the central area of the flues. These two forces operate widely different upon the resisting powers of the boiler, which taken in the direction of its exterior envelope has to resist a tensile strain operating in every direction from within, and the internal flues acting as an arch over a powerful resistance to compression from without. It might be instructive as well as interesting to exhibit the nature of these powers, and determine the law by which vessels of this description are retained in shape; but this can only be done by experiment, and as these experiments would have to be conducted upon a large scale, and with great accuracy, in order to arrive at satisfactory results, we must abandon the idea for the present, and content ourselves with such information as we already possess. At some future period I may possibly devote my attention to this subject; it is one of great importance, and a series of well-conducted experiments would, I make no doubt, supply valuable data in the varied requirements of boiler construction, and their comparative powers of resistance to the united force of tension and compression.

From the existing state of our knowledge, we must rest satisfied with the fact, that the resisting powers of cylindrical flues to compression will be directly as their diameters, and we may therefore conclude that a circular flue, eighteen inches diameter, will resist double the pressure of one three feet diameter. Hence it follows that the resistance of wrought-iron plates of the circular form is to the force of compression as their diameters—the same, but with greatly diminished powers—as compared with the resistance of wrought-iron cylindrical plates to tension.

To show the amount of strain upon a high-pressure boiler 30 feet long, 6 feet diameter, having two internal flues, each 2 feet 3 inches diameter, working at a pressure of 50 lbs. on the square inch, we have only to multiply the

number of square feet of surface, 1,030, exposed to pressure, by 3·21, and we have the force of 3,319 tons, which a boiler of these dimensions has to sustain. I mention this to show that the statistics of pressure, when worked out, are not only curious in themselves, but instructive as regards a knowledge of the retaining powers of vessels so extensively used, and on which the bread of thousands depends. To pursue the subject a little further, let us suppose the pressure to be at 450 lbs. on the square inch, which a well constructed boiler of this description will bear before it bursts, and we have the enormous force of 29,871, or nearly 30,000 tons bottled up within a cylinder 30 feet long, and 6 feet diameter.

This is, however, inconsiderable when compared with the locomotive, and some marine boilers, which, from the number of tubes, present a much larger extent of surface to pressure. Locomotive engines are usually worked at 80 to 100 lbs. on the inch, and taking one of the usual construction, we shall find at 100 lbs. on the inch that it rushes forward on a rail with a pent-up force within its interior* of nearly 60,000 tons, which is rather increased than diminished at an accelerated speed.

In a stationary boiler charged with steam at a given pressure, it is evident that the forces are in perfect equilibrium, and the strain being the same in all directions, there will be no tendency to motion. Supposing, however, this equilibrium to be destroyed by accumulative pressure till rupture ensues; it then follows that the forces in one direction having ceased, the others in an opposite direction being active would project the boiler from its seat with a force equal to that which is discharged through the orifice of rupture. The direction of motion would depend upon the position of the ruptured part: if in the line of the centre of gravity, motion would ensue in that direction; if out of that line, an oblique or rotatory motion round the centre of gravity would be the result.

The velocity or quantity of motion produced in one direction would be equal to the intensity or quantity lost; and the velocity with which the body would move would be in the ratio of the

impulsive force, or the quantity lost. Therefore, the quantity of motion gained by an exploded boiler in one direction, will be as its weight and the quantity lost in that direction. These definitions are, however, more in the province of the mathematician, and may easily be computed from well-known formula on the laws of motion.

We now come to the rectangular forms, or flat surfaces, which are not so well calculated to resist pressure. Of these we may instance the fire-box of the locomotive boiler, the sides and flues of marine boilers—the latter of which, by the bye, are now superseded by those of the tubular form—and the flat ends of the cylindrical boilers, and others of weaker construction.

The locomotive boiler is frequently worked up to a pressure of 120 lbs. on the square inch, and at times when rising steep gradients, I have known the steam nearly as high as 200 lbs. on the inch. In a locomotive boiler subject to such an enormous working pressure it requires the utmost care and attention on the part of the engineer to satisfy himself that the flat surfaces of the fire-box are capable of resisting that pressure, and that every part of the boiler is so nearly balanced in its powers of resistance as that when one part is at the point of rupture every other part is on the point of yielding to the same uniform force. This appears to be an important consideration in mechanical constructions of every kind, as any material applied for the security of one part of a vessel subject to uniform pressure, whilst another part is left weak, is so much material thrown away; and in stationary boilers, or in moving bodies, such as locomotive engines and steam vessels, they are absolutely injurious, at least so far as the parts are disproportionate to each other, and the extra weight when maintained in motion becomes an expensive and unwieldy incumbrance. A knowledge of the strength of the materials used, judicious care, and the exercise of sound judgment in its distribution, are therefore some of the most essential qualifications of the practical engineer. Our limited knowledge, and defective principles of construction, are manifest from the numerous abortions which exist, and although I am free to communi-

cate all that I know on this subject, I nevertheless find myself deficient in many of the requirements necessary for the attainments of sound principles of construction.

Reverting to the question more immediately under consideration, it is, however, essential to give the requisite security to those parts which, if left unsupported, would involve the public as well as ourselves in the greatest jeopardy.

The greater portion of the fire-boxes of locomotive boilers, as before noticed, have the rectangular form, and in order to economise heat and give space for the furnace, it becomes necessary to have an interior and exterior shell; that which contains the furnace is generally made of copper, firmly united by rivets, and the exterior shell which covers the fire-box, is made of iron and united by rivets, in the same way as the copper fire-box. Now these plates would of themselves—unless supported by riveted stays—be totally inadequate to sustain the pressure. In fact, with one-tenth the strain, the copper fire-box would be forced inwards upon the furnace, and the external shell bulged outwards, and with every change of force these two flat surfaces would move backwards and forwards, like the sides of an inflated bladder, at the point of rupture. To prevent this, and give the large flat surfaces an approximate degree of strength with the other parts of the boiler, wrought-iron or copper stays, one inch diameter, are introduced; they are first screwed into the iron and copper on both sides to prevent leakage, and then firmly riveted to the interior and exterior plates. These stays are about six inches asunder, forming a series of squares, and each of them will resist a strain of about fifteen tons before it breaks.

Let us now suppose the greatest pressure contained in the boiler to be 200 lbs. on the square inch, and we have $6 \times 6 \times 200 = 7200$ lbs., or $3\frac{1}{4}$ tons, the force applied to a square of 36 inches; now as these squares are supported by four stays, each capable of sustaining 15 tons, we have $4 \times 15 = 60$ tons as the resisting powers of the stays, but the pressure is not divided amongst all the four, but each stay has

to sustain that pressure, consequently the ratio of strength to the pressure will be as $4\frac{1}{2}$ to 1 nearly, which is a very fair proportion for the resisting power of that part.

We have treated of the sides, but the top of the fire-box and the ends have also to be protected, and there being no plate but the circular top of the boiler from which to attach stays, it has been found more convenient and equally advantageous to secure those parts by a series of strong wrought-iron bars, from which the roof of the fire-box is suspended, and which effectually prevents it from being forced down upon the fire. It will not be necessary to go into the calculations of those parts; they are, when riveted to the dome or roof, of sufficient strength to resist a pressure of 300 to 400 lbs. on the square inch. This is, however, generally speaking, the weakest part of the boiler, with the exception probably of the flat ends, above the tubes in the smoke-box, where they are not carefully stayed.

In the flat ends of cylindrical boilers, and those of the marine construction, the same rule applies as regards construction; and the due proportion of the parts, as in those of the locomotive boilers, must be closely adhered to. Every description of boiler used in manufactories, and also those on board of steamers, should in my opinion be constructed to a bursting pressure of 400 to 500 lbs. on the square inch, and locomotive engine boilers, which are subjected to a much severer duty, to a bursting pressure of 600 to 700 lbs.

It now only remains for me to state that internal flues, such as contain the furnace in the interior of the boiler, should be kept as near as possible to the cylindrical form; and as wrought iron will yield to a force tending to crush it of about one-half of what would tear it asunder, the flue should in no case exceed one-half the diameter of the boiler, and with the same thickness of plates it may be considered equally safe to the other parts. In fact, the force of the compression is so different to that of tension, that I should advise the diameter of the internal flues to be in the ratio of 1 to $2\frac{1}{2}$ instead of 1 to 2 of the diameter of the boiler.

I will not trouble you with a descrip-

tion of the haycock, hemispherical, and waggon-shaped boilers—they are all bad as respects their powers of resistance, and ought to be entirely exploded. I shall congratulate the public when they disappear from the list of those constructions entitled to the confidence of the public, and the consideration of the man of science as well as the practical engineer.

In treating of this subject, I hope to show not only what *are* the probable causes of explosion, but what appears equally important, what *are not* the causes. So many theories (some of them exceedingly problematical) have been brought forward on the occasion of disastrous explosions, that it requires the utmost care and attention to circumstances before they are generally admitted. To acquire satisfactory evidence as to the precise condition of the boiler and furnaces before an explosion is next to impossible, as most frequently the parties in charge, and from whose mismanagement and neglect we may in many cases date the origin of the occurrence, are the first to become the victims of their own indiscretion, and we can only judge from the havoc and devastation that ensues as to the immediate cause of the event.

From this it follows that, in many of the explosions on record, few, if any, of the real circumstances of the case are made known, and we are left to draw conclusions from the appearance of the ruptured parts, and the terrific consequences which too frequently follow as a result. This want of evidence as to the precise condition of a boiler with all its valves and mountings, preceding an explosion, is much to be regretted, as it causes a degree of mystery to surround the whole transaction; and the vague and sometimes inaccurate testimony of witnesses, but too often baffles all attempts at research, and creates additional cause of alarm to all those exposed to the occurrence of similar dangers.

1st. *Boiler explosions arising from accumulated internal pressure.*—In nine cases out of ten a continuous increasing pressure of steam without the means of escape is probably the immediate cause of explosion; in some instances it arises from deficiency of water, but accidents of this kind are comparatively few in number, as we often find in tracing the

causes that they have their origin in undue pressure, emanating from progressive accumulation of steam of great force and intensity. Let us take an example—to some of which I am able to refer—and we shall find that a boiler under the influence of a furnace in active combustion (as the recipient of heat) will generate an immense quantity of steam, and unless this is carried off by the safety valve or the usual channels when generated, the greatest danger may be apprehended by the continuous increase of pressure that is taking place within the boiler. Suppose that from some cause the steam thus accumulated does not escape with the same rapidity with which it is generated, that the safety valves are either inadequate to the full discharge of the surplus steam, or that they are entirely inoperative, which is sometimes the case, and we have at once the clue to the injurious consequences which, as a matter of fact, are sure to follow. The event may be procrastinated, and repeated trials of the antagonist forces from within, and the resistance of the plates from without, may occur without any apparent danger, but these experiments often repeated will at length injure the resisting powers of the material, and the ultimatum will be the arrival of the fatal moment when the balance of the two forces are destroyed and explosion ensues. How very often do we find this to be the true cause of accidents arising from extreme internal pressure, and how very easily these accidents might be avoided by the attachment of proper safety valves to allow the steam to escape and relieve the boiler of those severe trials which ultimately lead to destruction. If a boiler, whose generative power be equal to 100, be worked at a pressure of 10 lbs. on the square inch, the area of the safety valves should also be equal to 100, in order to prevent a continuous increase of pressure; or in case of the adhesion of any of the valves, it is desirable that their areas should, collectively, be equal to 100. If two or more valves are used, 100 or 120 would then be the measure of outlet. Under these precautions, and a boiler so constructed, the risk of accident is greatly diminished; and provided one of the valves is kept in working order, beyond the reach of interference by the engineer, or any other person, we may venture to

assume that the means of escape are at hand, irrespective of the temporary stoppage of the usual channels for carrying off the steam. So many accidents have occurred from this cause—the defective state of the safety valves—that I must request the attention whilst I enumerate a few of the most prominent cases that have come before me. In the year 1845 a tremendous explosion took place at a cotton mill in Bolton. The boilers, three in number, were situated under the mill, and from unequal capacity in the safety valves, and even those imperfect, as they were probably fast, a terrific explosion of the weakest boiler took place, which tore up the plates along the bottom, and the steam having no outlet at the top, not only burst out the end next the furnace, demolishing the building in that direction, but tearing up the top on the opposite side, the boiler was projected upwards in an oblique direction, carrying the floors, walls, and every other obstruction before it; ultimately it lodged itself across the railway at some distance from the building. Looking at the disastrous consequences of this accident, and the number of persons—from 16 to 18—who lost their lives on the occasion, it became a subject of deep interest to the community that a close investigation should immediately be instituted, and a recommendation followed that every precaution should be used in the construction as well as the management of boilers.

The next fatal occurrence on record in that district was a boiler at Ashton-under-Lyne, which exploded under similar circumstances, namely, from excessive interior pressure, when four or five lives were lost; and again at Hyde, where a similar accident occurred from the same cause, which was afterwards traced to the insane act of the stoker or engineer, who prevented all means for the steam to escape down the safety valve.

There was a boiler exploded at Malaga, in Spain, some years since, and my reasons for noticing it in this place is to show that explosions may be apprehended from other causes than those enumerated in the divisions of this inquiry, and that is *incrustation*. Dr. Ritterbrandt says—in a paper read before the Institution of Civil Engineers, by an eminent chemist, Mr. West—"that a sudden evolution of steam under circumstances of incrustation is no

uncommon occurrence:" in several instances I have known this to be the case, particularly in marine boilers, where the incrustation from salt water becomes a serious grievance, either as regards the duration of the boiler, or the economy of fuel.

If it were supposed, as Dr. Ritterbrandt observes, that the boiler was incrustated to the extent of half an inch, it would at once be seen that nothing was more easy than to heat the boiler strongly, even to red heat, without the immediate contact of water. Under these circumstances, the hardened deposits being firmly attached to the plates, and forming an imperfect conductor of heat, would greatly increase the temperature of the iron, and the great difference of temperature thus induced between the material—and the greater expansibility of the iron—would cause the incrustation to separate from the plates, and the water rushing in between them would generate a considerable charge of highly elastic steam, and thus endanger the security of the boiler.

These phenomena were singularly exemplified in the Malaga explosion, which is thus described by Mr. Hick:—"I have ascertained that a very thick incrustation of salt was found on the lower part of the boiler, immediately over the fire, and so far as it extended the plates appear to have been red hot, thereby much weakened, and hence the explosion. The ordinary working pressure of the boiler is 130 lbs. per square inch, and perhaps at the time of the explosion very much above that pressure, as there was only one small safety valve of two and a half inches diameter. The boiler was only two feet six inches diameter, and twenty feet long."

Incrustation, exclusive of being dangerous, is attended with great expense and injury to the boiler by its removal. In the case of the Transatlantic, Oriental, or other long sea-going vessels—even after the use of brine-pumps, blowing out, &c.—a very large amount of incrustation is formed, and considerable sums of money are expended each voyage to remove it.

Other explosions of a more recent date are those which occurred at Bradford and Halifax. They are still fresh in the recollection of the public mind, and are so

well known as not to require notice in this place.

I cannot, however, leave this part of the subject without reverting to an accident which occurred on the Lancashire and Yorkshire Railway, which had its origin in the same cause—excessive internal pressure. This accident is the more peculiar as it led to a long mathematical disquisition as to the nature of the forces which produced results at once curious and interesting. The conclusions which I arrived at, although *practically right, were, however, considered by some mathematically wrong*, as they were firmly combated by several eminent mathematicians; and notwithstanding the number of algebraic formulas, and the learned discussions of my friends on that occasion, I have been unable to change the opinion I then formed of others more conclusive.

The accident here alluded to, occurred to the "Irk" locomotive engine, which in February, 1845, blew up and killed the driver, stoker, and another person who was standing near the spot at the time. A great difference of opinion as to the cause of this accident was prevalent in the minds of those who witnessed the explosion, some attributing it to a crack in the copper fire-box, and others to the weakness of the stays over the top—neither of these opinions were, however, correct, as it was afterwards demonstrated that the material was not only entirely free from cracks and flaws, but the stays were proved sufficient to resist a pressure of 150 to 200 lbs. on the square inch. The true cause was afterwards ascertained to arise from the fastening down the safety valve of engine (an active fire being in operation under the boiler at the time) which was under the shed, with the steam up, ready to start with the early morning train.

The effect of this was the forcing down of the top of the copper fire-box upon the blazing embers of the furnace, which, acting upon the principle of the rocket, elevated the boiler and engine of 20 tons weight to the height of 30 feet, which, in its ascent, made a summerset in the air, passed through the roof of the shed, and ultimately landed at a distance of 60 yards from its original position. The question which excited most interest, was the absolute force required to fracture the

fire-box, its peculiar properties, when once liberated, and the elastic or continuous powers in operation, which forced the engine from its place to an elevation of 30 feet from the position on which it stood. An elaborate mathematical discussion ensued relative to the nature of these forces, which ended in the opinion that a pressure sufficient to rupture the fire-box, was by its continuous action sufficient to elevate the boiler and produce the results which followed. Another reason was assigned, namely, that an accumulated force of elastic vapor, at a high temperature, with no outlet through the valves, having suddenly burst upon the glowing embers of the furnace, would charge the products of combustion with their equivalents of oxygen, and hence explosion followed. Whether one or both of these two causes were in operation, is probably difficult to determine; at all events we have in many instances precisely the same results produced from similar causes, and unless greater precaution is used in the prevention of excessive pressure, we may naturally expect a repetition of the same fatal results.

The preventives against accidents of this kind are well-constructed boilers of the strongest form, and duly proportioned safety valves,—one under the immediate control of the engineer, and the other, as a reserve, under the keeping of some competent authority.

2nd. *Explosions from deficiency of water.*

This division of the subject requires the utmost care and attention, as the circumstance of boilers being short of water is no unusual occurrence. Imminent danger frequently arises from this cause, and it cannot be too forcibly impressed upon the minds of engineers, that there is no part of the apparatus which constitutes the mountings of a boiler which requires greater attention—probably the safety-valves not excepted—than that which supplies it with water. A well-constructed pump, and self-acting feeders—when boilers are worked at a low pressure—are indispensable, and where the latter cannot be applied, the glass tubular gauge steam and water cocks must have more than ordinary attention.

In a properly constructed boiler every part of the metal exposed to the

direct action of the fire should be in immediate contact with the water, and when proper provision is made to maintain the water at a uniform height and depth above the plates, accidents can never occur from this cause.

Should the water, however, get low from defects in the pump, or any stoppage of the regulating feed valves, and the plates over the furnace become red-hot, we then risk the bursting of the boiler, even at the ordinary working pressure. We have no occasion, under such circumstances, to search for another cause, from the fact that the material when raised to a red heat has lost about five-sixths of its strength, and a force of less than one-sixth will be found amply sufficient to bear down the plates direct upon the fire, or to burst the boiler.

When a boiler becomes short of water, the first and perhaps the most natural action is to run to the feed valve, and pull it wide open. This certainly remedies the deficiency, but increases the danger, by suddenly pouring upon the incandescent plates, a large body of water, which, coming in contact with a reservoir of intense heat, is calculated to produce highly elastic steam. This has been hitherto controverted by several eminent chemists and philosophers, but I make no doubt such is the case, unless the pressure has forced the plates into a concave shape, which for a time would retard the evaporation of the water when suddenly thrown upon them.—Some curious experimental facts have been elicited on this subject, and those of M. Boutigney, and Professor Bowman of King's College, London, show that a small quantity of water projected upon a hot plate does not touch it; that it forms itself into a globule surrounded with a thin film, and rolls about upon the plate without the least appearance of evaporation. A repulsive action takes place, and these phenomena are explained upon the supposition that the spheroid has a perfectly reflecting surface, and consequently the heat of the incandescent plate is reflected back upon it. What is, however, the most extraordinary in these experiments is, the fact that the globule, whilst rolling upon a red-hot plate, never exceeds a temperature of about 204 degrees of Fahrenheit; and in order to produce ebullition, it is

necessary to cool the plate until the water begins to boil, when it is rapidly dissipated in steam.

The experiments by the committee of the Franklin Institute, on this subject, give some interesting and useful results. That committee found that the temperature of clean iron, at which it vaporized drops of water was 334° Fahrenheit. The development of a repulsive force, which I have endeavored to describe, was, however, so rapid above that temperature, that drops which required but one second of time to disappear at the temperature of maximum vaporization, required 152 seconds when the metal was heated to 395° of Fahrenheit. The committee goes on to state that—"One ounce of water was introduced into an iron bowl three-sixteenths of an inch thick, and supplied with heat by an oil-bath at the temperature of 546° , was vaporized in fifteen seconds, while at the initial temperature of 507° , that of the most rapid evaporation was thirteen seconds."

The cooling effect of the metal is here strikingly exemplified, by the increased rapidity of the evaporation, which at a reduced temperature of 38° is effected in thirteen instead of fifteen seconds.

This does not, however, hold good in every case, as an increased quantity of water, say from one-eighth of an ounce to two ounces, thrown upon heated plates, raised the temperature of its evaporation from 460° to 600° Fahrenheit; thus clearly showing that the time required for the generation of explosive steam under these circumstances is attended with danger, and it may be doubted, whether the ordinary safety valves may not be wholly inadequate for its escape.

Numerous examples may be quoted to show that explosions from deficiency of water, although less frequent than those arising from undue pressure, are by no means uncommon—they are, nevertheless, comparatively fewer in number, and the preventives are good pumps, self-acting feeders (when they can be applied), and all those conveniences, such as water cocks, water gauges, floats, alarms, and other indicators of the loss and reduction of water in the boiler.

3rd. *Explosions produced from collapse.*

Accidents from this cause can scarcely be called explosions, as they arise, not from internal force, which bursts the boiler, but from the sudden action of a vacuum within it. In high-pressure boilers, from their superior strength and circular form, these accidents seldom occur, and the low-pressure boiler is effectually guarded against it by a valve which opens inward by the pressure of the atmosphere whenever a vacuum occurs. In some cases a collapse of the internal flues of boilers has been known to take place, from a partial vacuum within, which, united to the pressure of the steam, has forced down the top and sides of the flue, and with fatal effect discharged the contents of the boiler into the ash-pit, and destroyed and scalded everything before it. A circumstance of this kind occurred on the Thames, on board the steamer *Victoria*, some years since, when a number of persons lost their lives, and serious injury was sustained in all parts of the vessel within its reach. This accident could not, however, be called an explosion, but a collapse of the internal flues, which were of large dimensions, and the consequent discharge of large quantities of steam and water into the space occupied by the engines.

One or two cases which bear more directly on this point are, however, on record, and one of them, which took place in the Mold Mines, in Flintshire, was attended with explosion. The particulars, as given by Mr. John Taylor, will be found circumstantially reeorded in the first volume of the *Philosophical Magazine*. This occurrence seems to prove that rarefaction produced in the flues of a high-pressure boiler may determine an explosion. The boiler which exploded belonged to a set of three feeding the same engine; the fuel used was bituminous coal. The furnace doors of all three of the boilers had been opened, and the dampers of two had been closed, when a gust of flame was seen to issue from the mouth of the furnace of these latter, and was immediately followed by an explosion. The interior flue of this boiler was flattened from the sides, the flue and shell of the boiler remaining in their places, and the safety-valve upon the latter not being injured.

Other similar cases of collapse might be stated, but as most of them have been

attended by a defective supply of water in the boiler, the plates over the fire having become heated, they can scarcely be included in the category of this class of accidents, and more properly belong to those of which we have just treated,—explosions from a deficiency of water in the boiler.

It is nevertheless necessary to observe that cases of collapse should be carefully guarded against, as the great source of danger is in the escape of hot water, which, with the steam generated by it, produces death in one of its worst and most painful forms.

The remedies for these accidents will be found in the vacuum valve, and careful construction in the form and strength of the flues.

4th. Explosions from defective construction.

This is, perhaps, one of the most important divisions that can possibly engage our attention, and on which it shall be my duty to enlarge. In a previous inquiry I have already shown the nature of the strain, and the ultimate resistance which the material used in the construction of boilers is able to bear. We have not, however, in all cases, shown the distribution and position in which that material should be placed in order to attain the maximum of strength, and afford to the public greater security in the resisting powers of vessels subject to so severe and sometimes ruinous pressure. This is a subject of such importance that I shall be under the necessity of trespassing upon your time, in endeavoring to point out the advantages peculiar to form, and the use of a sound and perfect system of construction.

For a number of years, the haycock, hemispherical, and wagon-shaped boilers were those generally in use, and it was not until high-pressure steam was first introduced into Cornwall, that the cylindrical form with hemispherical ends, and the furnace under the boiler, came into use; subsequently this gave way to the introduction of a large internal flue, extending the whole length of the boiler, and in this the furnace was placed. For many years this was the best and most economical boiler in Cornwall, and its introduction into this country has effected great improvements in the economy of fuel as well as the strength of the

boiler. Several attempts have been made to improve this boiler by cutting away one-half of the end, in order to admit a larger furnace. This was first done by the Butterley Company, and it has since gone by the name of the Butterley boiler. This construction has the same defects as the haycock or *hemispherical* and wagon-shaped boilers; it is weak over the fire-place, and cannot well be strengthened without injury to the other parts of the boiler, from the vast number of stays necessary to suspend the part which forms the canopy of the furnace. Of late years, a much greater improvement has, however, been effected by the double flue and double furnace boiler, which is now in general use, and has nearly superseded all the other constructions. It consists of the cylindrical form, varying from five to seven feet in diameter, with two flues, which extend the whole length of the boiler; they are perfectly cylindrical, and of sufficient magnitude to admit a furnace in each. This boiler is the simplest and probably the most effective that has yet been constructed. It presents a large flue surface as the recipient of heat, and the double flues, when riveted to the flat ends, add greatly to the security and strength of those parts. It moreover admits of the new process of alternate firing, so highly conducive to perfect combustion, and the prevention of the nuisance of smoke.

5th. Explosions arising from mismanagement or ignorance.

To mismanagement, ignorance, and the misapplication of a few leading principles in connexion with the use and application of steam, may be traced the great majority of accidents which from time to time occur. Many of these accidents, so fruitful of the destruction of property and human life, might be prevented, if we had well constructed vessels judiciously united to skill and competency in the management. To convey a few practical instructions to engineers, stokers, and engine-men, would be an undertaking of no great difficulty. A young man of ordinary capacity would learn all that is necessary in a few months; and if placed under competent instructors, he might be made acquainted with the properties of steam, its elastic force at different degrees of pressure, the advantages peculiar to sensitive and

easy-working safety-valves, the necessity for cleanliness and keeping them in good working condition; the use of water gauges, fusion plugs, indicators, signals, &c., &c., connected with the supply and height of water in the boiler. The dangers to be apprehended from a scarcity of water, the danger of explosion when the engine is standing, or when the usual channels for relieving the boiler of its surplus steam are stopped,—all these are parts of elementary instruction which the stoker, as well as the engineer, should be acquainted with, and no proprietor of a mill, captain of a steam-ship, or superintendent of locomotive, should give employment to any person unless they can produce certificates of good behaviour, and a knowledge of the elementary principles of their profession.

If these precautions were adopted, greater care observed in the selection of men of skill and responsibility in the construction of boilers, and a more strict and rigid code of laws in the management, we may look forward with greater certainty to a considerable diminution, if not a prevention, of those calamitous events which so frequently plunge whole families into mourning by unexpected and instantaneous death.

As an individual, I would cheerfully lend my best assistance to the development of a principle of instruction calculated to relieve the country of the ignorance which pervades that part of the community on which the lives of so many depend. A resolution on the part of those who employ persons of this description, and whose interests are so much at stake, to take none whose knowledge and character does not come up to the requisite standard, *and pay for it*, would soon find, from the economy of the management, and the increased security of their property, a very important change in all the requirements of the economy, as well as the application of steam. How often do we find implements of danger, and vessels containing the elements of destruction, in the hands of the most ignorant and reckless practitioners, whose insensibility to danger, and total incompetency to judge of its presence, renders them, above all others, the most unfit to be employed. And why? because they are the very persons, from their defective knowledge, to increase the danger and

aggravate the evils they were selected to prevent. It is not the first time that engineers, to secure (if I may use the expression) an insane pressure, have fastened the safety-valves, and screwed down the steam-valve, closing every outlet, without ever thinking of the fire that was blazing under the boiler.

Under such circumstances, what could be expected but a blow up? A madman rushing with a lighted match into a powder magazine could not act with greater insanity: such, however, has been the case, and that arising from want of thought, or, what is worse, from the total absence of knowledge which it was the duty of his employer, as well as himself, to have possessed.

I have, on former occasions, stated that I am not an advocate for legislative interference, either in the construction or management of boilers, but, seeing the dangerous tendency of these vessels when placed under the control of ignorance and incapacity, I would forego many considerations to encourage a more judicious and intelligent class of men than has hitherto been employed in the care and management of steam and the steam-engine. The reforms necessary to be introduced may be done by the owners of steam-engines, steam-boats, railways, and others engaged in the use and application of this important element. A desire to enforce more judicious and stringent regulations, to remunerate talent, and to employ only those whose good conduct and superior knowledge entitled them to confidence, is the only sure guarantee of public safety and the prosperity of the employer.

Lastly, *The remedies applicable for the prevention of accidents arising from explosion.*

Having noticed, in the foregoing remarks, most of the causes incident to boiler explosions, it now only remains to draw such inferences as will point out the circumstances which it is desirable to cultivate, and others which it is desirable to avoid. These circumstances I have endeavoured to class in such way as to bring the subject prominently forward, and to point out, under each head, first, the causes which lead to accident; and secondly, the means necessary to be observed in avoiding it. In a general summary it may not be inexpedient briefly to

recapitulate these statements, in order to impress more forcibly upon the mind of those concerned the necessity for care and consideration in the use of one of the most powerful agents ever placed at our disposal.

One of the most scientific nations of Europe places the greatest confidence, as a means of safety, on the use of a fusible metal plate over the furnace. These plates are alloys of tin and lead with a small portion of bismuth, in such proportions as will ensure fusion at a temperature something below that of molten lead. In France, the greatest importance is attached to these alloys, and in order to insure certainty as to the definite proportions, the plates are prepared at the royal mint, where they may be purchased duly prepared for use. In this country these alloys are not generally in use, but in this respect I think we are wrong, as boiler explosions are not so frequent in France as in this country, and high-pressure steam, from its superior economy, is more extensively used in France than in England. In my own practice, I invariably insert a lead rivet one inch in diameter immediately over the fire-place, and as lead melts at 640 degrees, I have invariably found these metallic plugs a great security in the event of a scarcity of water in the boiler. I am persuaded many dangerous explosions may be avoided by the use of this simple and effective precaution, and as pure lead melts at 600 degrees, we may infer from this circumstance that notice will be given and relief obtained before the internal pressure of the steam exceeds that of the resisting powers of the heated plates. As this simple precaution is so easily accomplished, I would advise its general adoption. It can do no harm to the boiler, and may be the means of averting explosions and the destruction of many valuable lives.

The fusible metal plates, as used in France, are generally covered by a perforated metallic disc, which protects the alloy of which the plate is composed, and allows it to ooze through as soon as the steam has attained the temperature necessary to insure the fusion of the plate. The nature of the alloy is, however, somewhat curious, as the different equivalents have different degrees of fluidity, and the portion which is the first

to melt is forced out by the pressure of the steam, leaving the adhesion of the less fusible parts in a most imperfect state, incapable of resisting the internal force of the steam. The result of these compounds is, the fusion of one portion of the alloy and the fracture of the other, which is generally burst by pressure.

This latter description of fusible plates is different to the lead plug over the fire, as the one is fused at 600 degrees by the heat of the furnace, and the other by the temperature of the steam raised to the fusible point of the alloy, which varies from 280 to 350 degrees.

Another method is the bursting plate, fixed in a frame and attached to some convenient part of the upper side of the boiler; this plate to be of such thickness and of such ductility as to cause rupture whenever the pressure exceeds that of the weight on the safety-valve. There can be no doubt that such an apparatus, if made with a sufficiently large opening, would relieve the boiler; but the objection to this and several other devices is the frequent bursting of those plates, and the effect every change of pressure has upon the material in reducing its powers of resistance, and thus increasing uncertainty as to the amount of pressure in the boiler, as well as the constant renewal of the plates.

It has already been noticed that one of the most important securities against explosions is a duly proportioned boiler, well constructed, and to this must be added ample means for the escape of the steam on every occasion when the usual channels have been suddenly stopped. The only legitimate outlets under these circumstances appear to me to be the safety-valves, which, connected with this inquiry, are indispensable to security. Every boiler should, therefore, have two safety-valves, of sufficient capacity to carry off the quantity of steam generated by the boiler. One of these valves should be of the common construction, and the other beyond the reach of the engineer or any other person.

Defective construction is unquestionably one of the greatest sources of the frightful accidents which we are so frequently called upon to witness. No man should be allowed unlimited exercise of judgment in a question of such vital importance as the construction of a boiler,

unless duly qualified by matured experience in the theoretical and practical knowledge of form, strength of materials, and other requirements requisite to insure the maxim of sound construction. It appears to me equally important that we should have the same proofs and acknowledged system of operations in the construction of boilers, as we have in the strength and proportions of ordnance. In both cases we have to deal with a powerful and dangerous element, and I have yet to learn why the same security should not be given to the general public as we find so liberally extended to an important branch of the public service. In the ordnance department at Woolwich (with which I have been more or less connected for many years) the utmost care and precision is observed in the manufacture of guns, and the proofs are so carefully made, under the superintendence of competent officers, as to render every gun an engine of perfect safety to the extent of 1,000 to 1,200 rounds of shot.



THE BOILER HOUSE OF THE CRYSTAL PALACE.

To supply steam for the gratuitous use of exhibitors of "machinery in motion," the commissioners erected a boiler house without the Great Building, on the south side of "Rotten Row," at a distance of 155 feet from the north-west angle of the Palace. The whole length of the boiler-house is 96 feet from centre to centre of columns, and the width 24 feet, the principle of construction being the same as that adopted in the "Industrial Palace"—cast-iron columns at intervals of 8 feet and 24 feet respectively, and 24 feet trellis-girders, forming the framework of the structure; while instead of close boarding as an inclosure, 9-inch brick walls are substituted. The building is divided into three compartments by two cross brick walls of one brick and a half in thickness, which support a capacious cold water tank. The largest compartment, at the east end, is for the boilers, being 50 feet in length; the middle compartment, intended for stores, 20 feet; and the western com-

partment, also for stores, 26 feet in length, respectively. From the level of the ground to the top of the trellis-girders, is 22 feet 2 inches. Over the boiler department, the roofing is of corrugated iron, whereas over the western division, Mr. Paxton's "ridge and furrow" roofing, exactly similar to that of the great building, is used. The tank is formed of cast-iron plates, bolted together by means of internal flanges in the ordinary way. It is 21 feet square, and 4 feet 6 inches in depth; consequently will contain rather more than 55½ tons of water. There are altogether five boilers, all set in brick-work; the largest one is in the middle, and is from the works of Messrs. Galway of Manchester, consisting of two large horizontal tables or cylinders communicating with each other at 4 feet 10 inches from the front of the surface, and at the other end four vertical tubes of 8 inches diameter, passing from the lower to the upper part of the boiler, and 10 conoidal tubes for the same purpose; the whole length of the boiler being 13 feet, and the diameter 3 feet 4 inches. The smaller boilers, two on each side of that already mentioned, are of the high-pressure multitubular construction, as used for locomotive engines, being 3 feet 8 inches in diameter, and consisting of 41 horizontal tubes, each of 2¼ inches diameter: a cast-iron bracket is riveted to each side of the boiler to secure it to the brickwork, the flame first acting on the bottom and sides of the boiler, which is supported intermediately by two cross walls, and returning through the tubes towards the chimney, which is fixed at the furnace end of the boiler. The chimney is constructed of iron plates, riveted together, being circular, of 16 inches clear diameter, and 21 feet high. The pipes to convey the steam into the "machinery in motion" department are of cast-iron, of 8½ inches diameter internally, connected together by flanges in the usual way, and coated externally with felt. The underground channel for these pipes is formed by a foundation of 3-inch paving, on which are built dwarf 9-inch sides of brick, in cement, 21 inches high, the whole being covered at top by two planks, the lower one of 4 inches and the upper one of 3 inches in thickness respectively.

We extract from the *London Builder* the organizations and functions of the Juries by whom the prizes are to be awarded in the Great Exhibition.

There are thirty juries, one for each of the thirty classes into which the articles exhibited have been divided, and these juries are formed into six groups. Each jury has a chairman, and has elected from its own body a deputy-chairman, and a reporter, the duty of the latter being, as the title tells, to draw up a report upon the class of subjects submitted to his jury. These reports will be published, and, if properly made, will describe the state of industry of all nations, and form a permanent record of the Exhibition itself. The juries have to award two medals, the medium size (to be called the "Prize Medal") and the large medal. The small medal has been withdrawn, and will be disposed of by the Royal Commissioners, probably presented to those who, although unrewarded by the juries, are thought to deserve acknowledgment for assistance afforded by them. When a jury has decided on its awards, these awards will have to be submitted to a meeting of all the juries in the same group for confirmation: they will then go to the council of chairmen, to secure uniformity of acting, and will become final so soon as the latter report that they are in conformity to the rules laid down.

The great medal is to be awarded by the council of chairmen only, upon the recommendations made to that body by the juries: each jury must obtain the sanction of its own group of juries to its recommendation of the great medal, before the council of chairmen can take the recommendation into consideration. This medal is to be given only for very pre-eminent and indisputable merit; and the number distributed will be small. The medals, we may add, are to be awarded for excellence only, without reference to countries, or to degrees in the same kind of merit. Instructions as to the grounds on which, according to the class, medals are to be awarded, have been given to the juries; and the foreign members of the different juries seem to fall very readily into the work.

THE HAMMER SUPERSEDED IN BLOOMING IRON

At the last Meeting of the Birmingham Institution of Mechanical Engineers, a paper was read "On a New Machine for Blooming Iron." The working portion of the machine consists of three eccentric, cuspidated, semi-lunar-shaped cams, working simultaneously, and all kept rotating in one direction by wheels and pinions, firmly connected together in a strong frame, and set in motion by a steam engine. The convex sides of these semi-cylindrical cams are deeply grooved and serrated, and their peculiar form is such, that on dropping a bloom of iron into the concavity of the upper cam, as it presents itself, it is immediately drawn into the vortex, or centre of motion, of the three cams at the instant when that opening is the largest. As they rotate, the convexities, in consequence of the eccentricities of the centres, approach nearer and nearer—the ridges and rough surfaces, squeezing, rolling, and kneading the iron in all directions, like squeezing a sponge in the hand. The cinders and impurities are thus ejected, and fall out beneath the machine; and the cams, in the latter part of their rotation, having closed the space between them to the smallest dimensions in the revolution, the bloom is elongated and ejected in the form of an iron cylinder. For the production of superior iron, it had hitherto been considered that the hammer was indispensable; but for all purposes of efficiency, rapidity of action, and economy, this machine, it was assumed, would come into general use. From its strength and simplicity, it would not cost in repairs 20*l.* a year; while a hammer involved expenses of ten times that amount, and the cost of replacing a broken hammer was well known in the iron trade to be a serious *item*. It turned out a finished bloom, entirely free from cinder, in twelve seconds, the engine working moderately; while under the hammer it could not be completed under eighty seconds. Thus, by the machine, the cylindrical bloom, when ejected, was still at welding heat, and could be at once passed through the rolls, while from the hammer it had again to pass through the furnace.—*London Mechanics' Magazine*.

ROTATION OF THE EARTH.

For Appletons' *Mechanics' Magazine and Engineers' Journal*.

As many persons do not understand how it is that an inflexible wire, carrying a pendulum at its lower extremity, and supported from above, can offer so little

friction on its point of support as not to be carried round by it, in the diurnal motion which the said point of support has in conjunction with the earth, let any body, to a hook or nail in the ceiling of their own room, attach a pendulum, suspended by a piece of thread, instead of wire, and then, I think, the earth's rotation can be made perfectly demonstrable in the most easy way. It is evident that the earth in its rotation will carry the hook or nail round with it; but the effect upon the thread will be a mere twisting of it at its upper extremity, not affecting in any way the lower part of it. Now, supposing even the twist in the thread to be communicated to the pendulum, which I suppose to be a ball, the only effect of such a twist would be to turn the ball round once in twenty-four (or more) hours, according to the latitude, without effecting in any possible way the direction of the plane of vibration.

The point not understood by most persons is, how the pendulum can be turned round without the direction of the plane of oscillation being turned round also; but if any one will take a watch and suspend it by the guard between his fingers, and then cause the watch to oscillate like a pendulum in any given direction, and if he then twists the guard once round between his fingers, he will perceive that the watch itself may be twisted round, but that the rotation of the watch will not at all affect the direction of the plane of its oscillation.

Considering these remarks to be important to the comprehension of the problem by the mass of people, they may, perhaps, be worthy of insertion.

I have several times tried the experiment myself, with a small iron ball suspended from the ceiling of my office by a piece of cotton, and was always perfectly successful. q.

NOTES ON THE U. S. STEAMSHIP "PRINCETON."

BY B. F. ISHERWOOD, CHIEF ENG. U. S. NAVY.

For Appleton's *Mechanics' Magazine & Engineers' Journal*.

There has been no vessel belonging to the United States Government of late years, that has been so prominently before the public as the "Princeton." She was built in 1843, and was one of three ex-

periments tried about the same time by the government on different systems of propulsion for ocean steam navigation; viz: the "Mississippi," and "Missouri," with common radial paddle wheels: the "Union," with Hunter's submerged wheel, and the "Princeton" with the screw propeller. The *Notes on the "Mississippi"* have been already published in the magazine, and the data afforded by the present paper will enable the reader to make a comparison, and draw his own conclusions, as to the relative excellence and adaptativeness of the rival systems as applied to the respective vessels.

Before proceeding further, it may be just to observe, that steam navigation owes the construction of the "Princeton" entirely to Capt. Stockton, to whose clear-sightedness in comprehending the merits of the screw system of propulsion, and moral courage in advocating and illustrating it, is due the introduction of screw propellers in our navy, and in fact in our country; for until the "Princeton" had shown the peculiarities of the screw system on a large scale, and practically demonstrated its excellence, nothing had been attempted but a few small experiments.

Hull.—The hull of the "Princeton" was 164 feet in length on deck, 156 feet between perpendiculars, 30½ feet extreme beam, depth of lower hold to berth deck 14 feet, from birth to spar deck 7½ feet. Total depth of vessel 21½ feet. Measurement burthen, 673 tons. Launching weight of hull, 418 tons. Displacement at 16½ feet draught, 954 tons; at 18 feet draught, 1046 tons. Immersed amidship section at 16½ feet draught, 346 square feet; at 18 feet draught, 390 square feet. Draught of water at deepest load, with 200 tons of coal on board, 19 feet 4 inches aft and 16 feet 8 inches forward, mean 18 feet. With 100 tons of coal, in after part of bunkers, and provisions and water for the crew half out, the draught was 14 feet 9 inches forward and 18 feet 3 inches aft, mean 16½ feet. The draught at the dead flat was, for a mean, 17 feet. The peculiarity of model consisted in a very flat floor amidships, with great sharpness forward and excessive leanness aft, the run being remarkably fine, with a great extent of dead wood terminating in a stern post of the unusual thickness of 26 inches at the

centre of the propeller shaft, but tapering above and below. This dead wood and stern post was pierced by a hole 13 inches diameter for the passage of the propeller shaft. The stern, measuring from a perpendicular from the aft end of the spar deck, overhung the stern post $15\frac{1}{2}$ feet, and depending from it was a false stern post, leaving a space of 6 feet fore and aft between it and the true stern post. The propeller was placed within this space. The false stern post was composed of a wrought-iron bar covered with half inch thick copper plate; it was attached at top by composition flanges to a strong oak knee securely bolted to the counter of the vessel; at the lower part of it was attached by similar flanges to a solid oak timber, placed as a continuation of the keel beyond the true stern post; this timber was 14 inches deep and securely bolted to the keel and dead wood. The metal false stern post was $5\frac{3}{8}$ inches broad athwartship, and 2 feet long fore and aft; the forward part was brought to a sharp angle to diminish its resistance to the water, while its after part was square to receive the attachment of the rudder.

The rudder is also composite in its construction, being formed of a wrought-iron frame, the interstices of which are filled in with pieces of 5-inch thick pine plank, the whole cased up with copper plate $\frac{3}{16}$ inch thick. The thickness of the rudder athwartship is the same as that of the false stern post, viz: $5\frac{3}{8}$ inches.

Rig.—The "Princeton" was ship rig.

Engines.—The engines were two in number, and called by their patentee (Capt. Ericson), "*Semi-cylindrical Steam Engine*." This form of engine was invented, and originally patented by James Watt, the great improver of the steam engine; consequently the elaboration of the details is the only part to be placed to the credit of Ericson. The peculiarity of this form of engine consists in the use of a portion, instead of the whole of a cylinder, the piston being a parallelogram fitting the portion used of the cylinder lengthwise, instead of being a circle fitting the cylinder cross-wise. This parallelogram piston is hung on a shaft (whose centre is the axis of the semi-cylinder) and having journals to vibrate upon; it is made steam-tight by packing

all its edges, and is operated by admitting and educting steam on opposite sides simultaneously, as in other forms of engine; the piston vibrates through an arc of 90 degrees, and the remaining 90 degrees of the semi-cylinder are occupied by the cylinder cover in two pieces, each occupying 45 degrees. The piston-shafts passing through stuffing boxes at each end of the semi-cylinders, have at the forward end crank levers of 34 inches throw keyed on; from the ends of these levers, connecting-rods 74 inches long, connect on the same crank-pin, and drives the propeller-shaft, there being but one crank to both engines—the propeller making one revolution for each two vibrations of the piston.

The working surface in each piston measures 96 inches in length by 26 inches broad, giving an area of 2496 square inches. The centre of pressure of each piston moves through an arc 36 inches long. The "Princeton's" engines are therefore equal to two ordinary engines of cylinders $57\frac{1}{2}$ inches diameter by 3 feet stroke of piston. The aggregate capacity of the cylinders are 108'19 cubic feet.

The feed and air pumps are worked from the other extremity of the piston-shafts, by crank levers of the proper throw; the whole making a very simple and compact arrangement. The space occupied by the engines would be circumscribed by a parallelopipedon 17 ft. $\times$ 17 ft. $\times$ 6 ft. high. The nominal power of the engines is 250 horses. The space occupied by them, though small, is no less than would take in either trunk, four piston-rod or oscillating engines of equal stroke and diameter of cylinder. The cost of the engines alone, complete, was \$65,628 11. They weighed 193,024 pounds, making the cost 34 cents per pound. It may be useful to compare the cost of these engines per pound with the cost of two other engines made for the government at about the same time.

"Princeton,"	cost of engines per			
pound,	-	-	-	34 cts.
"Michigan,"	do.	do.	-	24 "
"Missouri,"	do.	do.	-	23 $\frac{1}{2}$ "

The principal objections to this form of engine are, the greater waste of steam in the clearance of the cylinders, the

greater friction of the pistons, and the necessity of better workmanship. Each clearance of the "Princeton's" cylinders amounts to about 4130 cubic inches, while an equal clearance to a $57\frac{1}{2}$ inches diameter cylinder (equivalent to the "Princeton's") is only 2597 cubic inches. The friction surface of the "Princeton's" pistons is about 24 feet for each piston, while for the piston of an equivalent cylinder of $57\frac{1}{2}$ inches diameter, this length would be only 15 feet. The difficulty of repairing the packing of the pistons is very great, and requires the very best workmanship—a condition not always at hand.

The engines when first built made a vacuum of 27 inches of mercury, but after some wear of the piston packings, it was with difficulty maintained at 23 inches, and frequently fell to 19 inches.

The condenser capacity was about 20 cubic feet, or 37 per cent. of the space displacement of the steam piston.

The air-pump was 28 inches diameter, and 21 inches stroke of piston; space displacement of piston, 7.48 cubic feet, or 13.8 per cent. of the space displacement of the steam piston.

Size of steam ports, 18 by 6 inches; area 108 square inches, or 1 square inch to about each 866 cubic inches of cylinder.

Boilers.—The boilers were of iron, 3 in number, and intended for the consumption of anthracite coal. Each boiler was 9 feet 4 inches high, 7 feet broad and 26 feet long. The three contained an aggregate heating surface of 2500 square feet and 134 square feet of grate surface. They weighed each 38,080 pounds, and the water in all three then weighed 76,160 pounds, making an aggregate total of 190,400 pounds. They cost \$23,250 or $20\frac{3.5}{100}$ cents per pound. The steam room capacity of the boilers is 1150 cubic feet. The aggregate calorimeter or cross area of flue at bridge wall is 27.12 square feet;—at back connections 33.19 square feet. Area of smoke-pipe 13.63 square feet. The smoke-pipe was 50 inches diameter and made in two pieces, the upper piece sliding into the lower one, telescope fashion. The lower piece was 17 feet in height above top of boiler, and the upper piece could be raised to an additional height of 12 feet, making a total of 29 feet. The object of this arrange-

ment was to give the ship the appearance of a sailing vessel only when the upper pipe was lowered into the lower one, in which case it did not project above the cook's galley which masked it; and as anthracite was burned with a blast, there was no betrayal by the smoke, the blast being substituted for a natural draft which could only be obtained by sufficient elevation of pipe. The proportions of the boilers would, from the above figures, be as follows:

Proportion of heating to grate surface,	18.65 to 1.00
" " calorimeter at bridge,	1.00 " 4.94
" " " connections,	1.00 " 4.04
" " " chimney,	1.00 " 9.83
" " steam room to cylinder capacity,	10.63 " 1.00
" " heating surface to cylinder capacity,	23.1 square foot to 1 cubic foot.

With such proportions, it was of course impossible to generate much steam with the natural draught, even with the pipe at its highest elevation. The utmost of anthracite that could be burned per hour in the grates with natural draft was 800 pounds, or 6 pounds per square foot per hour, a totally inadequate amount to generate the necessary quantity of steam for ordinary speed. This deficiency of natural draught was remedied by the use of two blowing engines with steam cylinders 9 inches diameter by 12 inches stroke of piston, working without condensation. Each cylinder drove a fan blower of 4 feet diameter, with 6 fans, $22\frac{1}{2}$ inches by 12 inches, each geared up 6 times. The blowers could be driven up to 500 revolutions per minute.

By forcing the blowers, 3700 pounds of anthracite coal could be burned per hour on the grates, or 27.61 pounds per square foot of grate per hour. This consumption of fuel would furnish steam enough to fill the cylinders 36 times per minute, (the boiler prepared being 20 pounds above the atmosphere, cutting off at $\frac{3}{8}$ from commencement of stroke. With this enormous consumption of coal per square foot of grate, and the small proportion of heating to grate surface, viz: 18.65 to 1.00 to absorb the caloric, a high economical evaporation cannot be expected. The steam valve was a short slide, and the cutting off was effected by a separate slide behind the steam valve. The cubic contents of the steam passages between the cut-off valve and cylinder, including clearance, are 13.36 cubic feet for the two cylinders. The capacity

of the two cylinders filled per stroke, cutting off at $\frac{3}{8}$, is 40.57 cubic feet; adding to this 13.36 cubic feet, we have the total 53.93 cubic feet, filled 72 times per minute, with steam of a total pressure of 33 pounds per square inch, (which supposes the initial pressure to be 2 pounds less than in the boiler. This should give per hour $(53.93 \times 72 \times 60)$ 232977.60 cubic feet of steam, and as 33 pounds per square inch total pressure and water occupy bulbs relatively as 810 to 1;— 232977.60 divided by 810 gives 287.62 cubic feet of water, and taking the weight of sea water at 64.3 pounds per cubic foot, we have 18493.97 pounds of water evaporated per hour by 3700 pounds of anthracite coal, or 5.00 pounds of sea water per pound of coal; to this must be added the loss by "blowing off" so as to maintain the saturation of the water at $\frac{2}{32}$, which loss is about $12\frac{6}{10}$ per cent. of the total caloric imparted to the water, or equivalent to the evaporation of 0.72 pound; adding this to the above obtained 5 pounds, we have a total of 5.72 pounds of sea water evaporated per hour per pound of anthracite coal.

This evaporation, though but little more than $\frac{6}{10}$ of what could be obtained in a properly proportioned boiler; yet when the small proportion of heating to grate surface is considered, it will appear a remarkable result. This arises from the use of anthracite with a blower, a mode of burning this species of fuel giving a high result.

THE NEW MOTIVE POWER.

To the Editor:

There is an article in the August number of your journal, which I am convinced was written by you upon first impressions, and not as the result of investigation of the particular project which you have, I think, erroneously confounded with a class of proposed inventions which have proved failures as a necessary consequence of their conflict with the very laws of nature upon which they were based. I refer to your comments on Sawyer & Gwinne's proposed new static pressure engine. Allow me to call your attention to the point of difference between it and the various projects along with which you have so un-

ceremoniously classed it. All of these projects involve the attempt to cheat gravity or leverage by merely shifting the point of application of the power, and hence until water will run up by its own gravity, or until a man can lift himself by his own waistbands, or until some other violent reversal of known laws—known and admitted equally by these would-be inventors and held as the basis of their operations—their projects must fail. But now for the difference. The basis of Mr. Sawyer's proposed engine is entirely distinct. He does not attempt to defraud any of the known mechanical laws, or to persuade them into any action different from their known propensities and settled habits; but on the contrary he announces the supposed discovery of a *new* mechanical law, of an additional or auxiliary force to those hitherto known and used, and he simply affirms that by the aid of this new law and new force, coupled with and reinforcing the old mechanical laws and forces, acting precisely in the old way, he can accomplish mechanical results which were never accomplished before. I am certain that you have unintentionally, and I will add, very naturally misapprehended him, and that you will be glad to have your attention directed to the real point in question, and that you will permit me as the friend and advocate of the inventors, to make this word of explanation in your columns.

It is obvious, under this statement, that there is, before any judgment can be formed upon this subject, a previous question to be settled. Has Mr. Sawyer pointed out, and clearly demonstrated the existence of, and does he propose to use a new or hitherto unobserved mechanical law and mechanical force? Does such a force exist in nature as he asserts, acting as he asserts it does?

If so, then all the old criticisms upon attempts to produce results similar to those he proposes are obsolete and must be abandoned as entirely out of place. If not, then the true point of attack is to show that it is not so, that he is wrong in his *philosophy* so far as that philosophy is new. This brings us back to the real first point at issue. Mr. Sawyer announces, as the result of both theory and experiment—experiment of the most prolonged, exact, and varied nature—that

centrifugal force—that force which breaks up a wheel when rapidly rotatal, is not, as heretofore supposed, merely a *mode* of the exhibition of the circular momentum of the wheel; that it is not in any exact sense the *result* of the power applied to rotate the wheel, but that it is really and truly a new and independent force, exhibited by nature only under the condition of rotation, it is true, but still not *due mechanically* to the power that causes the rotation; that it is no task on that power; that it can be used *itself as a mechanical power*, just as independent of the original power applied to rotate the wheel as gravity is; that herein is a grand mechanical and philosophical discovery which lifts the world at once into an entirely new mechanical sphere, and is going to enable us to perform, daily, miracles in mechanics, which under the old laws of mechanics, those hitherto known, acknowledged and worked upon, were simply absurd. I have examined Mr. Sawyer's models and experiments, and listened to his reasonings upon the subject, and am thoroughly convinced that he has made a genuine discovery of one of the laws of nature, which is going to unlock another storehouse of mechanical results, a thousand times richer and more varied than all that has been given us before. I believe if you will examine the subject you will be forced, against all your prejudices, to come to the same conclusion.

The following list of propositions will place the matter in a clearer light.

1. Centrifugal force increases in the ratio of the square of the velocity, as stated in all the books.

2. The rotation which evolves or demonstrates the centrifugal force is *very nearly* doubled by double the power applied. If the moving power be doubled, with a slight addition to overcome additional friction and atmospheric resistance, it will be found that in moving through the same space in the same time, it will give twice the former velocity.

3. Consequently, that under a high ratio of velocity the centrifugal force must be, and actually is, twenty, thirty, fifty and one hundred times as great as the power applied.

4. That *force or pressure without motion is power restrained*, and that *force or*

pressure which acts or produces motion or overcomes restraint is power.

5. Consequently, that if centrifugal force can be applied to produce motion, it then becomes a mechanical power, and may be used as such.

6. That centrifugal force *can* be applied as a power in throwing fluid off from a centre, as when water is whirled in a pail.

7. That by throwing fluid off from a centre in a vessel closed above and below, a vacuum can be created and maintained as long as the rotation is continued.

8. That centrifugal force is no tax upon rotation, that it is no retarding cause, as inertia and friction are.

9. Consequently, that the power gained by centrifugal force is a *pure donation of Nature, costing nothing*; that is, that it is no subtraction from the circular momentum, which last, with the friction, accounts fully for all the power applied.

10. Consequently, that centrifugal force is an *independent law of Nature*, as much so as gravity, exhibiting itself only under the condition of rotation, but not being chargeable upon the power applied to cause the rotation.

11. That, consequently again, a vacuum can be constituted and maintained by a power—centrifugal force rendered active by applying it to a liquid—which costs nothing mechanically, which Nature bestows gratuitously—the mechanical properties of the wheel rotated being just as great in the ordinary manner when the vacuum is created as when it is not.

12. That wherever and whenever a vacuum is made and maintained, the atmosphere outside can then be made to force a fluid into the vacuum—which vacuum is constantly renewed by the rotation; and the current of fluid thus put in motion by the atmospheric pressure, acting on a screw, or otherwise applied, can be used to propel machinery.

13. That the motive power thus obtained can be augmented to an extent only limited by the strength of the material, by compressing the atmosphere, while the power required to be applied to cause the rotation remains the same.

There are some other points which remain to be stated in another article.

One word in conclusion, with regard to

the gross injustice which your remarks are calculated to do to Mr. Sawyer, in relation to his effort to raise, on the strength of his ideas, the means of testing the correctness of those ideas in the form of a working engine. You entirely misapprehend him when you class him among reckless speculators seeking to fleece the public, and in inflict on him a wrong deeper I am certain than you contemplated when you penned your article. Whatever may be the validity of his supposed discovery and invention, he is himself a genuine devotee to mechanical science and discovery, and in my opinion the profoundest investigator in the particular direction he has chosen, whom the world has yet seen. He has spent years of time and a liberal fortune in presenting an immense range of experiment. He has exhausted his means just at the time when he believes that he has arrived at a discovery of immense magnitude. Can you tell me now, what course a man, honestly believing, profoundly convinced that he has in his possession an idea of immense value to the world, which only waits to be clothed in wood and iron to be visible to mankind, and without the means of so clothing it, can proceed with propriety?

Is there any more honorable course than for him to lay his supposed discoveries and inventions fully and fairly open before the world, and to invite the criticisms of science, and challenge the test of experiment? Is there any felony committed in his offering to such capitalists as will enable him to build an engine, a participation in the fruits of success? Ought the man who is driven by necessity, a necessity brought on him by his devotion to science, to avail himself of such an appeal to the generosity or the cupidity of the world to be met by the abuse (if you will allow me the term) of the very organs of that science, and of that branch of science which he is seeking to advance? Well assured that there was no malicious intention in your comments, and that you only fell into the natural error of classification, where a broad distinction really exists. I shall not prosecute a current of remarks which wounded sensibility of an enthusiastic discoverer, or the sympathising feelings of a personal friend of such person would prompt.

STEPHEN PEARL ANDREWS.

We give place to the above communication, perhaps of but little value to many of our readers, but as it embodies the principle upon which the "newly discovered law of nature" exists, it may not be wholly without interest.

The discussion of this new law can only result in good; for of our own knowledge, its promulgation has induced an examination and study of central forces by many who would have otherwise passed the subject by as one fully understood, and therefore but little likely to afford any new results.

There is no known law of nature, the study of which will not repay all that may be expended upon it, and this one of the central forces, like many others' is not too well understood. But in order to examine the laws of combustion it is not necessary to burn your fingers—you may learn all the truths connected with centrifugal motion without purchasing the right to use it; and such would be our advice.

PATENTS.

List of Patents (with claims annexed) which issued from the United States Patent Office from the 27th day of May, 1851, to the 17th June, 1851, both inclusive.

TO NELSON BARLOW, of St. Louis, Mo., for *Improvement in Planing Machines*. Patented May 27, 1851.—I claim, first, the joining or hinging of the plane stock supporting frame, or its equivalent, at one end, and giving it an elastic bearing at its opposite end, as herein set forth, wherein the said plane stock supporting frame be used in connection with individually vibrating plane stocks, or with other descriptions of plane stocks or planing knives, or cutter, for the purpose of reducing or planing planks or boards upon their sides or edges. Second, I claim the combination of the supporting frame containing the adjustable plane stocks, H H, with the self-adjusting supporting frame containing the plane stocks, by which the inner or under surfaces of the plane stocks are made to form a self-adjusting bed on one side of a plank, whilst the knives in the stocks are operating upon and facing the opposite side of the

same; and by which the inner or under surfaces of the plane stocks are made to form an unyielding bed on one side of a plank, whilst the knives in the plane stocks are operating upon and reducing its opposite side, and by which a plank can be faced on one side, and reduced and faced upon its opposite side, at simultaneous operations, as set forth. Third, I claim the combination of the supporting frame containing the self-adjusting plane stocks, with the arbor of the roller at its forward end, and with the supporting frame containing the plane stocks at its rear end, for the purpose, in the first place, of so guiding the transversely reciprocating movements of the said plane stock supporting frames, as to keep the inner sides of the respective series of plane stocks contained therein parallel with each other, and parallel with the surfaces of the two pairs of rollers; and, in the second place, for the purpose of enabling the supporting frame containing the self-adjusting plane stocks to be detached from the supporting frame containing the adjustable plane stock, and be swung outwards upon the shaft of the roller, to afford free access to the inner sides of the plane stocks in both the said plane stock supporting frames, as set forth. Fourth, I claim the combination of the rollers with the plane stocks, when they are so arranged that the roller in one plane stock will form a rotating and self-adjusting mouth-piece to the planing knife that succeeds it, and at the same time form a bed on one side of a plank for a planing knife acting upon its opposite, as set forth. Fifth, I claim the giving to straight-edged planing or reducing knives or cutters that are arranged athwart the surfaces of the boards or planks operated upon, a transversely reciprocating movement, whilst a continuous longitudinal movement is imparted to the said boards or planks. Sixth, I claim the manner of producing a uniform elastic pressure upon the upper and lower bearing boxes of the arbors of the pressure rollers, viz., by means of pairs of screws arranged as herein described, and having threads inclining at angles of about 30° with their axes, which are banded together and operated upon by a weight, substantially as herein set forth. Seventh, I claim the improved stock that receives the tonguing cutters, composed of the central governing plate, combined with the projections on the two side plates as set forth. Eighth, I also claim the manner of combining the stationary cutters, with the governing centre plate, by means of the inclined projections on the sides of the said plate, the flaring notches in the plate, and the gibs having lugs at each extremity, placed in the said flaring notches, and acting upon the edges and front sides of the said cutters as set forth.

To JOHN C. POST, of White Haven, Pa., for *Improved Self-adjusting and locking Switch for Railroads*. Patented June 3, 1851.—I claim the combination of the counterpoise weights (four) or their equivalents, with the toggle levers (two) and stops, substantially as described, operating in the manner set forth.

To HORACE S. COOK, of Leominster, Mass., (assignee of H. S. Cook & Seneca Colburn, of same place), for *Improvement in Comb-Cutting Machines*. Patented June 3, 1851.—I claim as my improvement in comb-cutting machinery, making the cutters to operate or move separately and independently of each other and in regular succession, in combination with making them of different and the required lengths, so as to produce the separation of two combs from a comb plate, substantially in the manner and with the bottoming to their teeth, as specified.

To MARGARET HULINGS, of Randolph Co., Ind., for *Improvement in hand machines for Spinning Wool*. Patented June 3, 1851.—I claim the clamp, the inclined planes (two), the lifters (two), the adjustable stop, the trip, hand and ratchet, with another hand and ratchet, combined and arranged as set forth and described, or any analogous device for the purpose of spinning wool.

To SAMUEL B. HUTCHINS, of Oswegatchie, N. Y., for *Improved arrangement of machinery for actuating the Crank Indicator*. Patented June 3, 1851.—I claim the arrangement of bevel wheels (four) and their shafts (three) herein represented and described, the first in the series being actuated by a motion derived from the eccentric by means of a crank and pin, and the last giving motion to the indicator hand.

To DAVID & HERMAN WOLF, of Lebanon, Pa., for *Improvement in Seed Distributors of Seed Planters*. Patented June 3, 1851.—We claim, in combination with the notched transverse bar, the employment of the jointed cleavers projecting from the recesses of said bar into the apertures of slide bars, for preventing the choking of the apertures.

To JOSEPH W. BRIGGS, of Cleveland, O., for *Improvement in Collars for harness*. Patented June 3, 1851.—I claim the U shaped metallic breast-plate, suitably padded and made to fit around the neck of the horse, the same being so limited in length, as not to reach the shoulder-blades of the animal, and being suspended from the neck by a neck strap.

To PETER CLAUSSEN, of Great Charlotte St., Blackfriars, England, for *Improvement in process for treating vegetable fibre*. Dated June 3, 1851. Antedated Aug. 16, 1851.—I claim the preparation of vegetable fibre capable of being spun or felted, by submitting the plant from which the fibre is to be derived, to the action of caustic soda or other solutions of like properties, and then to that of sulphuric or sulphurous acid, in the manner set forth, whereby the gummy, glutinous, and other matters which connect the fibre with the woody portion of the plant, are dissolved and discharged; and at the same time effecting the discharge of the oleaginous and other coloring matters contained within the woody portions or straw, without staining the fibre.

Second, I claim splitting the fibres of vegetable matter, in preparing them for spinning, by the generation and liberation of carbonic acid, or other gas, within the cellular portions

of said fibres, in the manner described, or in any other manner, by which gas may be generated and liberated.

To JOSEPH OSBORN, of Weymouth, Mass., *for Improved Sash Stopper*. Patented June 3, 1851.—I claim arranging a sash stopper composed of the friction plate parallel to the side of the sash, and the bolt rising obliquely upward therefrom, in the manner herein set forth, so that the upward motion of the sash will relieve the same from the frictional resistance of the friction plate, by counteracting the force of said spring; and that the downward motion tendency of the sash will augment the frictional resistance of said friction plate by aiding the force of said spring.

To CYRUS AVERY, of Tunkhannock, Pa., *for Improvement in Horse Powers*. Patented June 3, 1851.—I claim, first, the employment of rollers (two) mounted or hung on the main shaft and lower guide shaft, in combination with the flanches on the wheels to retain said wheels upon their axles, when passing from one platform to the other, and to check their revolution.

To HENRY BESSEMER, of Baxter House, &c., Middlesex, Co., England, *for Improvement in Machines for expressing Cane Juice*. Dated June 3, 1851. Antedated Dec. 31, 1851.—I claim, first, the extraction of the juice from cane, by submitting the stalks of the same in perforated tubes or other vessels, constructed on the principle described herein, to a continuous pressure in the manner set forth, whereby time is afforded for the juice to flow from the cellular tissues, and re-absorption into the exhausted cane is avoided.

Secondly, the perforated compressing tubes having either a straight or a tapering bore.

Thirdly, the combination of the pistons with the perforated tubes and hoppers, whereby the operations of regulating the feed, cutting the canes into equal lengths, pressing and discharging the same, are effected substantially as set forth.

To MARSHALL J. HUNT, of Rising Sun, Md., *for Improvement of a Seed Planter*. Patented June 3, 1851.—I claim the arrangement and combination of the double bolt with its slotted arm, rock shaft, with its arms (two) and pitman, for the double purpose of giving motion to the feeding apparatus, and also regulating the quantity of seed to be sown, when said pitman is operated by a long crank upon which it travels, as shown.

To J. C. DICKEY, of Washington, D. C., *for Improvement in Revolving Frames for drying fruits and other articles*. Patented June 3, 1851.—I claim the centre with three or more arms, to support a cord netting or cloth, for the purpose of exposing cloths, clothes, glue, fruits, seeds, &c., with facility to be dried, so constructed that the arms may be raised up and brought together, to expedite the collection of the articles dried, and so that it may be conveniently removed when not in use.

I do not intend to limit my invention to the precise form of construction described, but to vary it to suit the circumstances in which it is to be used, while I accomplish the de-

sired object, by means substantially the same.

To RALPH B. BEACH, of Kensington, Pa., *for Improvement in ornamenting baked earthenware*. Patented June 3, 1851.—I claim, first, the application of coloring matter mixed with varnish or its equivalent, to the surface of baked earthenware, for the purpose of giving to such ware a surface of sufficient body and of sufficient brilliancy for ornamental purposes, thus obviating the necessity of the glazing process.

Second, the inlaying of pearls, gems, &c., on china and baked earthenware for ornamental purposes.

Third, the peculiar cement and process by which I affix pearls and gems to the china or baked earthenware.

To LEWIS S. CHICHESTER, of Williamsburgh, N. Y., *for Improvement in Carving Machines*. Patented June 3, 1851.—I claim the use of the pendent lever suspended from a ball and socket joint, in combination with a horizontal table for the pattern and block, the said table being affixed to the end of the pendent lever by a ball and socket joint, the whole being arranged with respect to the tracer and cutter.

I also claim preventing the pendent lever from changing its centre of motion, or from rotating on its own axis, or on any line passing through the centre of its motion, by the use of the bent arms working in balls in spherical sockets.

I also claim combining with the pendent lever, two or more tables, in the manner described, or in any other substantially the same, and arranged each with a tracer and cutter respectively, in order that large carvings may be obtained from a small pattern, or vice versa, or both at the same time and with the same machine.

To CHARLES F. BROWN, of Warren, R. I., *for Balanced Rudder*. Patented June 10, 1851. I claim the employment, for the purpose of steering ships and other vessels in water, of two rudders, hung upon and at equal distances from the same centre of motion, and with their surfaces parallel, or nearly so, with each other, in such a manner that the same resistance is offered to each by the vessel's motion through the water, and both are balanced substantially as herein described.

To DAVIS DUTCHER, of Springfield, N. Y., *for Improvement in Churns*, Antedated Feb. 15, 1851. Patented June 10, 1851. I claim the combination and arrangement of the arms (two) with their rollers (two), which are controlled by the crank and the swinging arms (two) with their floats (two) kept in proper place, both in churning and gathering and working the butter, by the resistance of the cream.

To T. W. HILL, of Leominster, Mass., *for Improvement in Comb-Cutting Machines*. Patented June 10, 1851. I claim the combination of the two series of lifters and bent levers *n*, (arranged upon the traveling carriage) with the pressure roller, in such manner, that the continued motion of the carriage, shall operate the lifters after the combs are cut.

To ROBERT NEWELL, of New York, N. Y.,

for Improvement in Permutation Safety Locks. Patented June 10, 1851. I claim, first, the application of the lever, B 5, and dog B 6, with the tusk, 40, to be acted on by the talon, 39, and allow the spring, 38, to throw the tusk, 40, into the notches on the lower part of the followers and auxiliary followers, so as to prevent any portion of these parts, if any of the tumblers are lifted after any end shake motion has been given to the bolt, by any improper attempt to unlock it.

Second, The combination of the tumblers, A, slides B 1, and follower, A 9, through the tenons, 13, notches, 20, tongue, 29, and jaws, 24, to lift the slides, B 1, and followers, A 9, to the same extent as the tumblers, A, and lifted by the key sections on locking the bolt, and to sustain the slides, B 1, until the tusk, 34, takes the notches, 31, on the slides, and holds them so that the bolt cannot be retracted until all the tumblers, A, are lifted to meet the notches, 30, and allow the springs, 25, levers, A 0, and auxiliary followers, A 8, to lift and place the followers, A 9, in the same position as when the bolt was projected.

Third, the mode described of so arranging and combining the cylinder, C 4, by the flanches, C 5, angles 60, tumblers, C and A, and pins, 47 and 49, with the detector lever, D, at the part C 1, as that no one of the tumblers A, can be separately lifted without placing the part, C 3, of the detector lever over the key hole, with the edges of the notch, 55, covering the open space around the drill pin, 57, by which arrangement no movement of the cylinder, C 4, can be made without producing the same effect, so that if powder is introduced into the cylinder, C 4, and the cylinder is moved, with the intent of entering a blow-pipe to spread the powder on either side of the cylinder, the part C 3 and notch 55 instantly cover the key hole and prevent the entry of the blow-pipe for such a purpose.

Fourth, the combination of the cylinder, C 4, block, 62, and hole, 63, to receive and pass out any gunpowder put in for the purpose of exploding, to destroy the lock, and at the same time, prevent the powder from reaching any other part of the lock.

Fifth, the application of the safety valve block, 64, to vent the explosion of any gunpowder that may be confined in the cylinder, C 4, by plugging both the key hole and the hole 63.

Sixth, The mode of fitting the key hole cover, C 3, with the notch, 55, in the detector lever, D, to match the neck, 56, on the key shank; such means also preventing the introduction of any pick or false instrument, after any movement has been given to the cylinder, C 4, by the notch 55, being as small as the drill pin, 57.

Seventh, the application of the guard-piece, 65, on the detector lever, D, to prevent a pick reaching the pin, 45 of the detent dog, B 8.

Eighth, the application of the cam pointed piece, C 6, on the detector lever, D, to move the pin, 47, and detent dog, B 8, so attached, that if the key hole cover is cut or drilled off, the piece, C 6, falls away and leaves the detent dog, B 8, still holding the bolt.

To I. S. RICHARDSON, of Boston, Mass., *for Improvement in Churns.* Patented June 10, 1851.—I claim, the combination of the rock shaft, levers, connecting rod, and swing for the churn, for the purpose of producing the perpendicular movement of the dasher, substantially in the manner herein described, to be denominated the Oscillating Perpendicular Dash Churn.

To A. C. ARNOLD of Norwalk, Conn., *for Improvement in crossing the fibres in forming the bats for felt, cloth, &c.* Patented June 10, 1851.—I claim, first, the employment, for the purpose of carrying webs, sheets, or layers, of any fibrous material, of an apron of material pervious to air, having a box in which a vacuum is produced placed at the back, the side of the box next the apron being perforated, or otherwise rendered pervious, so that the external air, rushing through the apron to fill the vacuum within the box, forces the material close to the apron and confines it there, in combination with the manner herein described, of throwing off or releasing the material from the apron by suddenly closing the valve in the pipe communicating between the vacuum box and the apparatus for producing the vacuum, and at the same time opening the valve in the said pipe to admit air into the box; or by any means substantially the same.

Second, the flap operating in the manner and for the purpose specified.

To G. H. CORLISS, of Providence, R. I., *for Improvement in Governors.* Patented June 10, 1851.—I claim the method of steadying the movement of governors of regulators of motion, by apparatus described, or the equivalent thereof.

To SOMMERS CROWELL, of Reading, Pa., *for Improvement in Railings.* Patented June 10, 1851.—I claim making the dovetailed tenons, whether to the paling, or top and bottom rails, wedge shaped in the length of the railing, the taper at the opposite ends being reverse, and making the grooves in the rails or palings in the same manner, that the palings cannot slide in either direction, binding the whole firmly together.

To ALBERT EAMES of Springfield, Mass., *for Improvement in Machines for Facing and Polishing Stone and other Substances.* Patented June 10, 1851.—I claim the method of grinding, facing, or polishing the surface of stones and other substances, by means of a grinder, rubber or polisher, connected and combined with a spindle, from which it derives a rotary motion, by means of universal and sliding joints, substantially as described, that the said grinder, rubber or polisher, may be carried over any and all parts of the surface to be worked, whilst its surface is self-adapting, as described.

To WM. GARDNER, of New York, N. Y., *for Improvement in Governors.* Patented June 10, 1851.—I claim the employment of a loose wheel or pulley propelled by the prime mover, and driving its shaft, through the action of a separate elastic force, weight, or pressure, such as procured by the spring in combination with the several racks and pin-

ions, or their equivalents, as described, for operating the adjusting or regulating slides.

To C. H. GUARD, of Brownville, N. Y., *for Improvement in Carriage Springs*. Patented June 10, 1851.—I claim connecting the axles of wheeled vehicles, by means of curved spring perches, which are combined with the supporting springs of the vehicle, that have a greater degree of curvature than themselves.

To JOHN O'NEIL, of Xenia, Ohio, *for Improvement in Washing Machines*. Patented June 10, 1851.—I claim the triple and concentrated action of pressure blocks upon the clothes; being constructed and operated, substantially in the manner described.

To HUGH and JAMES SANGSTER, of Buffalo, N. Y., *for Improvement in Lanterns*. Patented June 10, 1851.—We claim the mode of attaching the lamp to the lantern, by means of the springs and flanges.

To T. J. SLOAN, of New York, N. Y., *for Improvement in method of finishing the heads of screws*. Patented June 10, 1851.—I claim the method described, of finishing the heads in the manufacture of wood screws, partly shaving the head with a cutter before nicking, and after nicking subjecting it to a second shaving operation, to complete the shaving by means of a cutter, whose edges form with each other a more acute angle than the edges of the cutter first employed.

To WM. VAN ANDEN, of Poughkeepsie, N. Y., *for Improvement in Centrifugal Sugar Drainers*. Patented June 10, 1851.—I claim the contrivance for discharging, and at the same time cleansing the strainer whilst in motion, by means of an elevator rising in a spiral groove, substantially as described, or by an elevator rising in vertical or inclined grooves, which is essentially the same.

To N. T. ALLEN, of Ludlowville, N. Y., *for Improvement in Grain Harvesters*. Patented June 10, 1851.—I claim gearing the operating parts of the machine from both the wheels, in combination with the arrangement by which portions may be driven by either, so as to equalize the driving power upon each, and thus to allow the machine to be much more easily guided and controlled.

To MAHLON GREGG, of Philadelphia, Pa., *for Improvement in Brick Machines*. Patented June 17, 1851.—I claim the rotating mould wheel, constructed as described, with a series of moulds in its periphery, and an annular plane outside of the moulds, and furnished with pistons arranged as described for the purpose of discharging the bricks from the moulds.

I also claim the mode herein described, of changing the position of the pistons by means of the bar attached to the horizontal presser, with its block and plate which are made to impinge upon the vertical plates, which are attached to the pistons for that purpose.

I also claim the combination of the hopper, horizontal presser, vertical presser, and hook rod, with the transverse horizontal lever and with the mould wheel; the whole being constructed and arranged in the manner and for the purposes described.

To HIRAM W. HAYDEN, of Waterbury, Ct.,

for Improvement in the construction of Dies. Patented June 17, 1851.—I do not claim to be the first to construct a die with a lined surface, to deaden the metallic surface operated on, but I claim the application of a die, with a lined or corrugated surface, with the figure or pattern cut, or countersunk, so that the lined surface deadens the plate of polished metal, and leaves the polished surface of the figure untouched, for producing ornamental designs on polished metallic surfaces.

To ELIAS YOUNG, of Cincinnati, O., *for Improvement in Cooking Stoves*. Patented June 17, 1851.—I claim the cold air passages, substantially as arranged, to wit: having each an external aperture, near their upper part, on each side, beneath which projects a plate that carries the air to the center of the stove, whence, by a second plate, beneath the middle of the passage, it is again deflected to the outer ends of the passage, (thus counterbalancing the cooling effects at its entrance,) whence it is distributed in hot blasts, to the fire.

To WILLIAM T. BARNES, of Buffalo, N. Y., *for Improvement in Wash Boards*. Patented June 17, 1851.—First, I claim fastening cloth, or its equivalent, on the board to prevent fine fabrics from slipping and from being torn or rubbed too much; but I do not claim lining the grooved washboard with india rubber, or other equivalent material.

Second, I claim hinging the washboard to the frame, for the purpose of holding the clothes while being washed, and at the same time allowing the board to be turned over.

To RANSOM COOK, of Saratoga Springs, N. Y., *for Improvement in Augers*. Patented June 17, 1851.—I claim the form of the tips or cutting edges of boring implements, as described, that is, such tip commencing at the screw or center point, and running nearly at right angles thereto, until about half way from the centre to the outer part of the boring implement, when it assumes a curve upwards, or towards the handle end of the instrument, which curve is continued until it is nearly semicircular, or until it turns within the periphery of the auger or bit, the curved edges being also under-cut or back-sloped, but without being confined to any particular angle of such back-sloping or under-cutting.

To RUFUS ELLIS, of Northampton, Mass., (assignor to WILLIAM M. CHASE of Boston, Mass.,) *for Improvements in Knitting Machines*. Patented June 17, 1851.—I claim the arrangement of the needles in the pland of the endless belt, instead of at right angles to it, in combination with the arrangement of the driving pinion and the projecting joints, &c., of the links of the belt, on the outside of the belt, the belt being supported, and the whole being applied to the stitch hook, yarn guide, and presser, and made to operate together, and with the work hanging on the inside of the belt.

To CHARLES F. BROWN, of Warren, R. I., *for improved connection of Telescopic Masts and Spars*. Patented June 17, 1851.—I claim connecting and adjusting the several joints

of masts, yards, and all spars constructed of telescopic tubes, or tubes fitting one within another by means of a screwed rod or screwed rods (two), nuts, female screws, and set screws, or their equivalents; the whole being inserted in and secured or attached to the tubes, and operating in the manner substantially as set forth.

To SEYMOUR CARVER, of Geneva, Ill., for *Improvement in Machines for Dressing Shingles*. Patented June 17, 1851.—I claim the arrangement of the head block with the springs, cams, the rollers, and stops, for the purpose of passing the shingles between and out from the cutting cylinders, in combination with the arrangement for depressing the upper cylinder, while in motion for the purpose of giving a taper to the shingle.

To THATCHER C. HATCH, of South Braintree, Mass., for *Improvement in Ventilators*. Patented June 17, 1851.—I claim a ventilator as herein described, composed of two series or sets of curved slats, arranged one within the other, and running from the edge of the flue or other orifice, to a small circle or plate over the centre of the same, the whole forming a conical or globe-shaped ventilator, the spaces between the several outer slats being protected by the inner slats, having spaces or apertures between the two sets of slats, the only openings to said apertures being in an oblique or sideways direction.

To W. O. HICKOK, of Harrisburg, Pa., for *Improvement in Regulators for the pen beam of Ruling Machines*. Patented June 17, 1851.—I do not claim to be the inventor of the flexible hooked regulator, attached to the pen beam, but I claim the pieces in combination with the hinge joints, arranged and combined substantially as described.

I also claim the sliding piece, the bearings, and the finger wheel, in combination with the other pieces, uniting by hinge joints, or in any other manner substantially the same, using, in the construction of the whole machine, any material adapted to the purpose of forming, as described, a pen beam regulator for ruling machines.

To CHARLES ANDERSON, of Warren, Pa., for *Improvements in Revolving Boilers*. Patented June 17, 1851.—I claim lining the inside of that part of a revolving boiler which comes in contact with the fire or heat, with wire gauze, or cloth, or any perforated or pervious metal work.

Re-Issues.

To ESTHER L. LARKIN, Admx. of JOHN E. LARKIN, deceased, of Ballston, Spa, N. Y., for *method of attaching augers to their handles*. Patented Nov. 19, 1850. Re-issued June 17, 1851.—I claim the handle made in two parts, one of which fits in a socket on the other, and carries a bolt screwed at its end, the said bolt passing through a hole in the auger shank, and screwing into a female screw, or nut, in the part on which is the socket, for the purpose of clamping or firmly holding the auger shank between the ends of the parts of the handle or stock.

Designs.

To LYMAN S. HAPGOOD, of Boston, Mass., for *Design for Stove Plates*. Patented May 3, 1851.

To WILLIAM L. SANDERSON, of Troy, N. Y., [assignor to R. R. Finch, of Peekskill, N. Y.,] for *Design for Stoves*. Patented June 3, 1851.

To S. W. GIBBS, of Albany, N. Y., (assignor to JAGGER, TREADWELL & PERRY), for *Design for Stoves*. Patented June 10, 1851.

To W. G. HALLMAN, of Philadelphia, Pa., for *Design for Stoves*. Patented June 10, 1851.

To A. COX, ELIAS JOHNSON & D. B. COX, of Troy, N. Y., for *two Designs for Stoves*. Patented June 10, 1851.

To J. F. RATHBONE, of Albany, N. Y., for *Design for Stoves*. Patented June 10, 1851.

To DAVID STUART & JACOB BEESLEY, of Philadelphia, Pa., (assignor to W. P. CRESSON,) for *Design for Stoves*. Patented June 10, 1851.

To JOSEPH G. LAMB, of Cincinnati, O., for *Design for Stoves*. Patented June 17, 1851.

Last of English Patents issued from April 24, 1851, to May 14, 1851.

Thomas Parker, of Leeds, York, broker, for improvements in machinery for opening, cleaning, and preparing fibrous substances, and for manufacturing felted fabrics. June 3; six months.

John Hopkinson, of Oxford-street, Middlesex, piano-forte manufacturer, for improvements in piano-fortes. (Being a communication.) June 3; six months.

William Bridges Adams, of Adam-street, Adelphi, Middlesex, engineer, for certain improvements in the construction of roads and ways for the transit of passengers, of materials, and of goods; also in buildings and in bridges, and in locomotive engines and carriages; part of which improvements are applicable to other like purposes. June 3; six months.

Cornelius Alfred Jaquin, of New-street, Bishopsgate, London, mechanist, for improvements in the manufacture of nails, pins, tacks, screws, and other similar articles. June 3; six months.

Isaac Hazlehurst, of Marton, Dalton, Lancaster, steel refiner, for certain improvements in the manufacture of iron. June 3; six months.

James Banister, of Birmingham, brass-founder, for improvements in the manufacture of metallic tubes for steam boilers and other uses. June 7; six months.

Robert Alexander Kennedy, of Manchester, cotton-spinner, for improvements in machinery applicable to engines for carding cotton and other fibrous substances. June 10; six months.

William Henry Fox Talbot, of Laycock Abbey, Chippenham, Wilts, for improvements in photography. June 12; six months.

John Emanuel Lightfoot, of Broad Oak, Aerington, Lancaster, calico-printer, and James Higgin, of Coburg-terrace, Manchester, chemist, for improvements in treating and preparing certain coloring matters to be used in dyeing and printing. June 12; six months.

Frederick Crace Calvert, of Manchester, chemist, for a new application of certain fluids for manufacturing extracts applicable to the processes of dyeing, printing, and tanning, and in the apparatus connected therewith. June 12; six months.

John Chatterton, of Birmingham, agent, for certain improvements in protecting insulated electro-telegraphic wires, and in the methods and machinery used for the purpose. June 12; six months.

William Birkett, of Bradford, York, agent, for improvements in obtaining soap from wash waters. June 12; six months.

Felix Charles Victor Leon Levacher D'Urcle, of Paris, France, farmer, for improvements for increasing the produce of autumn wheat. June 12; six months.

Edward Lyon Berthon, of Fareham, Hants, clerk, master of arts, for improvements in boats, and in instruments for sounding and indicating the rise and fall and rate of currents. June 12; six months.

James Hinks, of Birmingham, Warwick, manufacturer, for certain improvements in the construction of metallic reels for winding cotton, silk and other threads, and in machinery for making the same. June 14; six months.

Prosper Durand, of Rue Maragrاند, Paris, merchant, for improvements in communicating intelligence. June 17; six months.

Thomas Crook, of Preston, Lancaster, manufacturer, and James Mason, of Preston aforesaid, warper, for certain improvements in looms for weaving.—June 14; six months.

Francis John Swaine Hepburn, of Notting-hill-terrace, Middlesex, captain, H. P. unattached, for improvements in the manufacture of carriages and other vehicles. June 17; six months.

Godfrey Ermen, of Manchester, cotton-spinner and manufacturer, for certain improvements in the method of and apparatus for finishing yarns or threads. June 17; six months.

Richard Fletcher, of Blackdowns Farm, in the parish of Ebrington, Gloucester, farmer, for an improvement in obtaining motive power. June 21; six months.

John Holmes, of Birmingham, machinist, for improvements in machinery for cutting and stamping metals. June 24; six months.

John Brazil, of Manchester, gentleman, for certain improvements in dyeing, and in the preparation of dye-woods. June 24; six months.

Richard Edward Hodges, of Southampton-row, Middlesex, gentleman, and William Brockedon, of Devonshire-street, in the same county, gentleman, for improvements in surgical instruments. June 24; six months.

Alexander Parkes, of Birmingham, for improvements in separating silver from other metals. June 24; six months.

George Jordan Firmin, of Lambeth-street, Goodman's-fields, Middlesex, manufacturing chemist, for improvements in the manufacture of oxalate of potass. June 21; six months.

List of Scotch Patents from 22d of May to the 22d of June, 1851.

John Gwynne, of Lansdowne-Lodge, Nuttinghill, Middlesex, merchant, for improvements in machinery for pumping, forcing, and exhausting of steam fluids and gasses, and in the adaptation thereof to producing motion; to the saturation, separation, and decomposition of substances. May 28; four months.

Charles Hardy, of Low Moor, York, engineer, for certain improvements in the manufacture of scythes. May 30; four months.

William Geddes, of Glasgow, dyer, for certain improvements in the production of ornamental fabrics. June 6; four months.

John M'Nab, of Middletownfield, Renfrew, North Britain, bleacher, for certain improvements in stretching and drying textile fabrics or materials, and in the machinery or apparatus employed therein. June 16; six months.

Isaac Hazlehurst, of Marton, in the parish of Dalton, Lancaster, steel refiner, for certain improvements in the manufacture of iron. June 16; six months.

Frederick Crace Calvert, of Manchester, professor of chemistry, and analytical chemist, for a new application of certain fluids for manufacturing extracts applicable to the processes of dyeing, printing, and

tanning, and in the apparatus connected therewith. June 18; six months.

Alexis Delemer, of Radcliff, Lancaster, civil engineer and merchant, for certain improvements in the application of colouring matter to linens, cottons, silks, woollens, and other wett, and also in machinery and apparatus for those purposes. June 19; four months.

Christopher Nickels, of York-road, Lambeth, Surrey, gentleman, for improvements in the manufacture of woollen and other fabrics. June 19; six months.

Henry C. Baildon, of Edinburgh, chemist, for improvements in writing, printing, or marking letters, characters, or figures upon paper, parchment, or other materials properly prepared for that purpose. June 19; six months.

George Robins Booth, of London, engineer, for improvements in the manufacture of gas. June 19; six months.

James Hartley, Sunderland, for improvements in the manufacture of glass. June 19; six months.

William Beadon, jun., of Taunton, Somerset, gentleman, for improvements applicable to the roofing of houses, buildings, and other structures. June 19; six months.

NOTICES AND CORRESPONDENCE.

NEW-YORK, Aug. 16, 1851.

Sir.—In No. 7 of your Magazine, two articles (copies from English periodicals) present the following positions.

1st. That the horses' power of the Baltic and Asia are respectively 2200 and 800.

2d. That "Mr. Frost's *stame*" is an American discovery.

The horses' power of the engines of the Asia, by the same rule that gives to those of the Baltic 2200, is 1850. Hence, the deductions of a writer endeavoring to show a superiority in the Asia, *pro rata* with her means, fall to the ground from an insufficient foundation.

Mr. Frost was an Englishman, and received his mechanical education in England; the reflection, therefore, cast upon "American discovery" fails to illustrate our absurdities, but not its purpose, for whilst the whole profession in England will read the charge, but a very few here will learn of its falsity.

II.

In answer to numerous enquiries on the subject, we append the following, as the simplest method with which we have any acquaintance. It is by J. Hunt, Esq., at present engineer of the New-Haven and New-London Railroad—a gentleman whose accuracy in such matters has long been unquestioned.

Formula for determining the proper distance between the switch and the point of the frog, when the turn-out is from a straight line.

Let S = angle of switch in degree, s = movement of switch in inches.

F = angle of frog in degree, g = width of track gauge in feet.

$$\text{Dist.} = 2(g - s) \times \frac{\cot S \times \cot F}{\cot S + \cot F}$$

For example: Suppose the switch to be 18 feet in length, and to have a movement of 5 inches; the frog to be 5 feet 8 inches long, 3 inches wide at the mouth, and 6 inches across the head, and the track gauge to be 4 feet 8 $\frac{1}{2}$ inches, or 4.708.

$$\cot S = \frac{216 \text{ in.}}{5 \text{ in.}} = 43.33 \quad \cot F = \frac{68 \text{ in.}}{9 \text{ in.}} = 7.55$$

$$g - s = 4.291 \text{ feet.}$$

$$\text{Dist.} = 2 \times 4.291 \times \frac{43.33 \times 7.55}{43.33 + 7.55} = 55.21 \text{ feet.}$$

It is to be noted that this is the distance to the point of the frog, which, in the above case, is one-third of its length from the end (or 1.83 feet.) Consequently the distance from the mouth of the switch to the mouth of the frog is 55.21 — 1.83 or 53.33 feet.

To the Editor of Appleton's *Mechanics' Magazine*.

Sir,—In reply to your comment on my communications in your August number, I would remark that the upper surface of the Eddystone rock dips to the S.W., and the courses below the 7th, or first entire course, only made good the deficiency to the extent of a level area of the required size, 26 feet. Had the upper surface of the rock been level, these lower courses would have been unnecessary, and the strength of the structure would have been even greater than it is. The first entire course is the largest in the structure, and the area of the rock at the bottom of the ocean may as fairly be considered the base of the structure, as the imaginary circle of which the four stones composing the first course form a small segment. K.

We notice in Mr. Greeley's (Tribune) account of machinery, &c., in the Great Exhibition, the following article:—

"Mr. J. S. Gwynne, of our State, whose 'Balanced Centrifugal Pump' made a sensation and obtained a gold medal at our Institute fair last October, is here with it, and proposes a public trial of its qualities, in competition with the rival English pumps of Appold and Bessimer, for \$1,000, to be paid by the loser to the Mechanics' Society. Mr. Gwynne claims that these English pumps (which have been among the chief attractions of the department of British Machinery,) are palpable plagiarisms from his invention, and not well done at that. He, of course, does not claim the idea of a Centrifugal Pump as his own, for it is much older than any of them, but he does claim that adaptation of the idea which has rendered it effective and valuable. I am reliably informed that he has just sold his Scotch patent only for the comfortable sum of £10,000 sterling, or nearly \$50,000; and this is but one of several inventions which he has found a ready market for here at liberal prices."

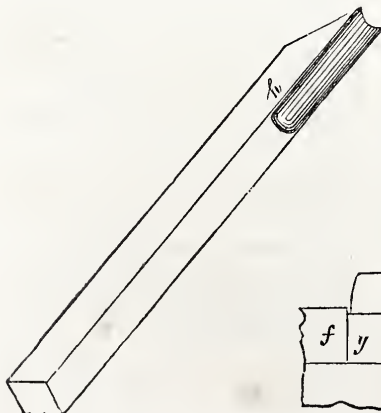
The charge of plagiarism, as coming from J. S. Gwynne, is rather too much—the whole of his so-called balanced pump being nothing more nor less

than Dimpfel's fan applied to raising water. As for the sale of his Scotch patent for \$50,000—it may be so, and it may not—the latter the more likely of the two. We give in a following number an illustration of the Centrifugal Pump of Appold, and shall, (if the proprietor of the pump will permit the experiment), give the result of similar experiments with the balanced pump, but must confess our entire disbelief in its pre-eminent virtues. We believe its claim rests entirely upon the newly-discovered law of nature, *that centrifugal force is an independent power in itself*; and when we add, that the inventor of the pump is the same Mr. Gwynne who is interested in the new motive power alluded to in our last number, the grounds for our disbelief will be apparent.

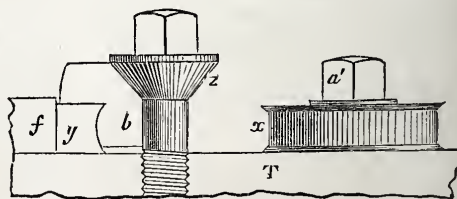
We have read the terms of the challenge referred to in the article of the Tribune, and notice one peculiarity, viz., that Mr. Gwynne proposes to run his pump for *one year* with Appold's pump, guaranteeing that with the same expenditure of power the balanced pump will discharge (only) *ten per cent. more water* than Appold's.

In the mean time, at the rate of \$50,000 for the right in Scotland, *while it was yet untried*, it is possible it may be a matter of indifference to Mr. Gwynne, at the close of the year, which proves the better pump.

"W. P. H., A SUBSCRIBER."—So soon as the drawings can be procured, and the engravings made, the subject will be brought under notice. We have now nearly ready the engravings, on a large scale, of the trunk engines used in the new propellers, Pioneer and City of Pittsburgh, built to run between this city and Liverpool. We anticipate more important results to our commercial marine, from experiments and experience in the adaptation of Propellers, than from any other branch of steam machinery; not that the side wheel is likely soon to be superseded, but the advantages resulting from the use of the Propeller as an *auxiliary*, will command for it the attention of engineers and the public for a long time yet to come.



✂ In the August number of the Magazine, the printer omitted two figures of details of Barlow's wood-planing machine. They are here annexed, and form a part of figure 3 referred to in the description of the machine. The figure marked 8 is not referred to in the description, but represents a portion of figure 2 drawn to an enlarged scale. Fig. 2 is also incorrectly numbered Fig. 3, and the reverse.



APPLETONS'

Mechanics' Magazine and Engineers' Journal.

VOL. I.

MONDAY, OCTOBER 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New York.

No. 10.

CUTLER'S IMPROVEMENTS IN METAL-PIPE MACHINERY.

Fig. 1.

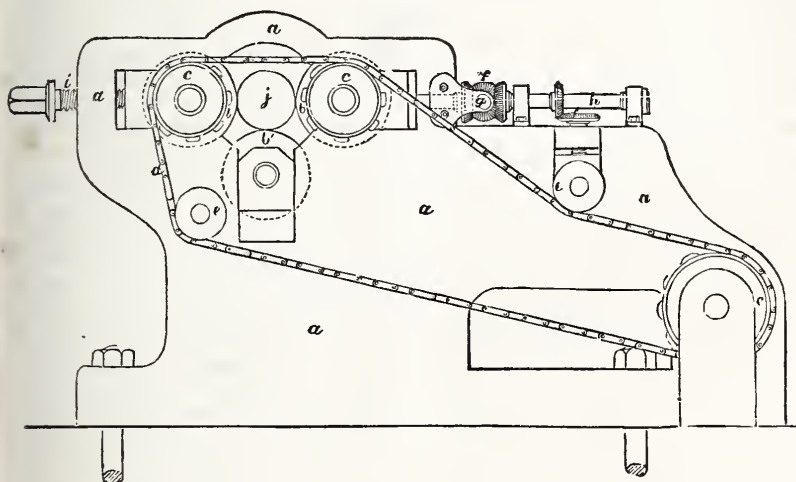
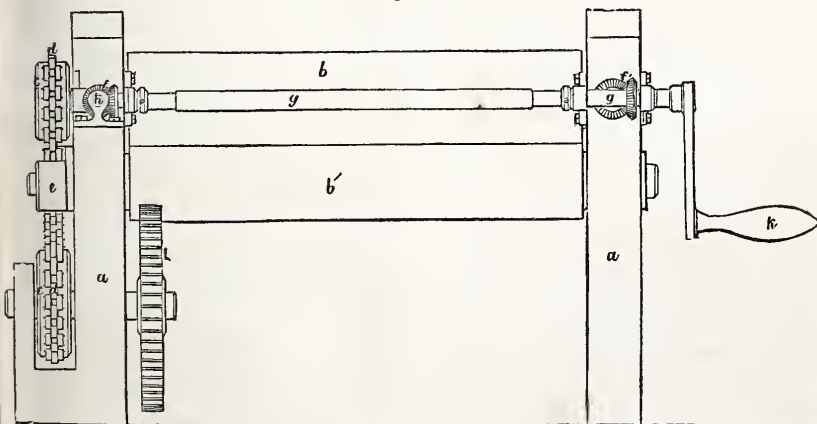


Fig. 2.



CUTLER'S IMPROVEMENTS IN THE MANUFACTURE OF METAL PIPE OR TUBES.

From the Specification of the Inventor, I. Cutler, of Birmingham.

My invention relates to improvements in the manufacture of metallic pipes or tubes, which have hitherto generally been brazed or soldered, and cold drawn, and with a seam or joint. The various methods hitherto ordinarily practised are as follow: If the tube about to be made is for a brazed or soldered joint tube, a strip of copper or brass, or other alloys of metals, is rolled into the required length, width, and thickness; it is then bevelled or chamfered on its two alternate edges; this being done, it is then turned up at the end some 9 to 12 inches of the strip of metal into a cylindrical shape, or nearly so, to enable it to pass through a die with a hole in it, commonly called a turning-up or lapping bed; the turned-up part of the strip is taken hold of by a pair of tongs attached to an endless chain fixed on a draw-bench, and being put in motion, the strip is drawn through the die (a plug being used with the die in this process), when the flat strip is converted into a round or cylindrical form, with one edge overlapping the other; this process being performed, it is then (what is termed) closed and bound round in places with wire to prevent its altering in shape while undergoing the process of brazing or soldering; it is then charged, that is, metal solder in a powdered state, mixed with borax, is placed along the seam or joint; it is then placed in a stove or small furnace and heated, a small portion at a time, to such a heat as to cause the solder to melt and run in the seam, thereby causing the two edges to be secured, the one on the top of the other; the process of soldering being completed, and the two edges secured firmly together, the wire bands are removed, and the tube is pickled and cleansed from the scale or oxide that has been formed by the soldering process. It is again taken to the bench and passed through holes or dies, and mandrels are passed through the tubes so as to make them round and cylindrical, and to make them the exact external diameter required; they are then stretched to make them straight. All the above processes are practised and well understood by brass or copper tube-makers. The expense attending the making of tubes by this process, and their imper-

fections when made, have led to many methods of manufacturing tubes without a brazed or soldered joint, as being more serviceable and advantageous for steam-boiler and other purposes, which tubes without seams or joints are now manufactured as follows: A brass cylinder is cast in a mould with a sand or iron bore inside, and when the metal is sufficiently cold the core is removed, and the brass cylinder annealed, and when cold pickled or cleansed from all oxide or scale, or other impure matter. When so cleansed, a mandrel of steel or iron well oiled or greased is inserted into the metal cylinder, which is then passed through holes or dies, or through grooved rolls, each hole or groove passed through being of smaller diameter than the hole or groove through which it had been previously drawn, which has the effect of reducing the thickness of the metal, and elongating the cylinder or tube; but this repeated drawing of the tube on a mandrel in a cold state having the effect of hardening the metal and causing it to crack very much, it is necessary to withdraw the mandrel from time to time by means of a draw-bench, for the purpose of annealing the tube to soften it, and then to pickle and cleanse the tube from the oxide or scale occasioned by such annealing, so that the same operation of withdrawing and reinserting the mandrel, of annealing and cleansing the tube, and of drawing the tube and mandrel through holes, or through grooves, in rolls, each time of smaller diameter, has to be repeated several times before the tube is reduced to the required length, diameter, and thickness; the withdrawing of the mandrel is often effected with great difficulty, and many tubes are spoiled and made waste in performing this operation. Others, instead of drawing the tubes through holes or dies, or through grooves in rolls by means of pliers attached to the endless chain of a draw-bench, adopt the principle or method of passing them through grooves in rolls by the means of the rolls being driven by geer or toothed wheels and worked by motive power, while the tube is in a cold state, the friction or pressure on the tube propelling it forwards; and by so rolling, the same

Fig. 3.

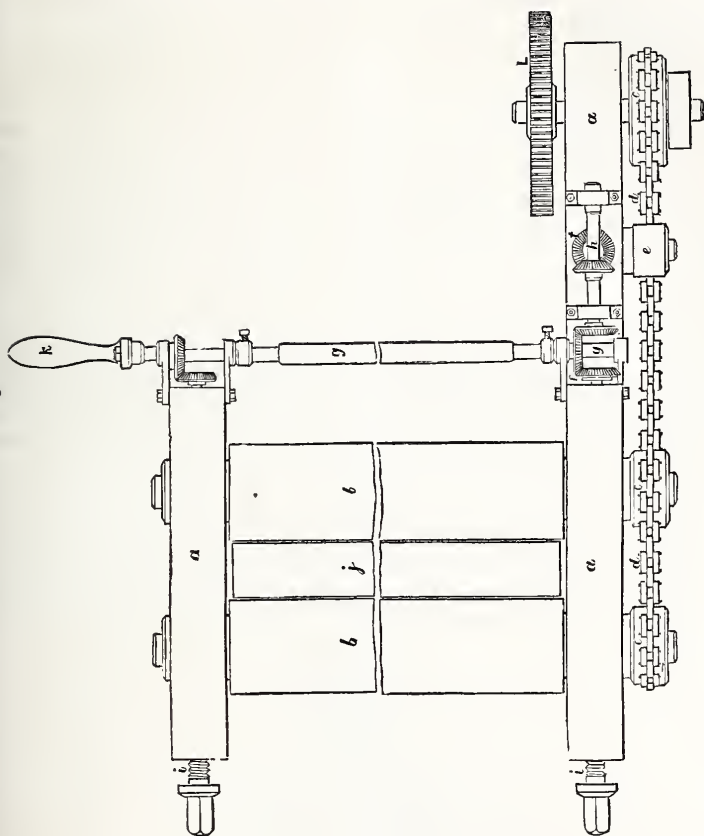


Fig. 4.

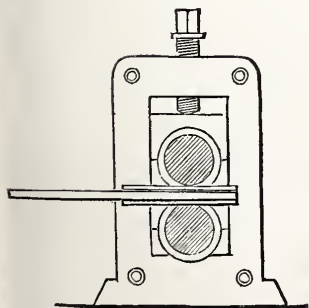


Fig. 5.

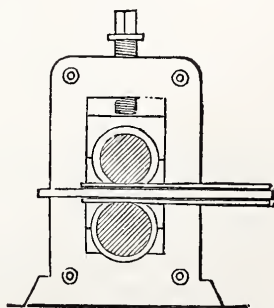


Fig. 6.

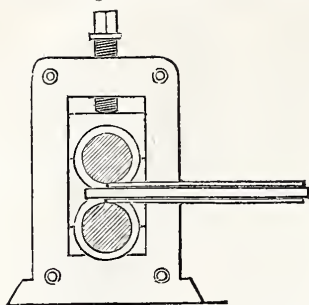
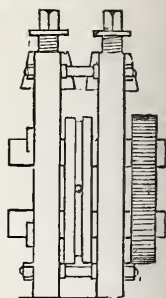


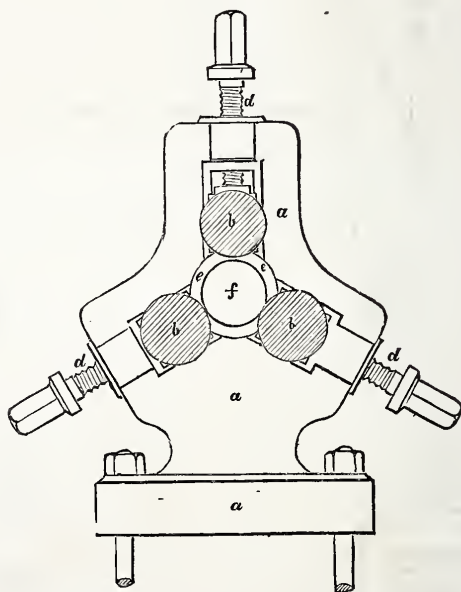
Fig. 7.



or nearly the same results are obtained as though they were driven or drawn by the aid of a draw-bench; the same withdrawing of the mandrel, the same amount of annealing, pickling, and cleansing, and

the same reinserting of the mandrel, and the same repeated rollings being necessary to prevent the metal from cracking, and to prevent the tube from being so firmly fixed on the mandrel as to render

Fig. 8.



it impossible to withdraw the mandrel without spoiling the tube, and to reduce it to the length, diameter, and thickness required.

The part of my invention which relates to the manufacture of tubes of copper or brass, or other metals or alloys of metals, is to be performed as follows: In making

metal tubes without seam or joint, if for a brass tube, I take the necessary proportions of copper and zinc, similar to Muntz's mixture for rolling hot (or the patent brass mixture of J. D. M. Stirling, as described in his specification enrolled in the High Court of Chancery of England, on the 29th day of December, 1846,

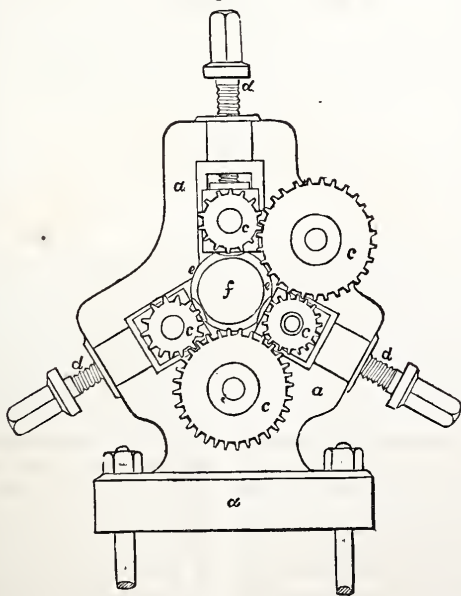
which will, in my opinion, be found to answer better), or any other mixture that will roll hot, and put such proportions into a casting-pot, which pot is in a furnace, and is well understood amongst metal-casters; when the metal is sufficiently heated, I proceed to run it into a mould or matrix, either of iron or steel, or other known substance. In the centre of the mould or matrix I place a core of sand, or other suitable or proper material, and which is well understood and practised by various branches of the metal trades, such as printing cylinders, blunderbuss barrels, casters, &c., the mould or matrix being of sufficient diameter to hold sufficient metal to enable the tube to be rolled out to the proper length, diameter, and thickness required. When this is done, the metal, in its melted or fluid state, is then poured into the mould or matrix so prepared, and when sufficiently cold and the metal set, I remove it from the mould or matrix, and also remove the core, and afterwards, if necessary, I pickle and clean it; I then place it in a furnace to become sufficiently hot to stand rolling; when in this state, I insert a mandrel within the tube, and proceed

to pass it through a series of grooves in rolls, each groove through which it passes in succession being smaller than the one through which it last passed, and in this way and by this means I continue to roll the tube while hot, until it is elongated to the required length and reduced to the required thickness, and the required, or nearly so, diameter.

In fig. 1 of the accompanying drawings, A represents a sectional elevation of the grooved rolls, suitably mounted in standards, through which the tube is first passed upon the mandrel; B is a similar elevation, showing the tube or pipe passing through the rolls on the mandrel; C is a similar elevation, showing the pipe or tube also on the mandrel, and just leaving the rolls; D is an elevation of the grooved rolls on their standards, showing the circle formed by their grooves.

Instead of using grooved rolls with single grooves in each set of rolls, as above described and shown in fig. 1, several sets of grooves of gradually increasing diameter may be turned in one pair of rolls, which are proportionately increased in length for that purpose, the rolls being made similar to those used

Fig. 9.



for rolling round iron ship bolts, &c. Other combinations of grooved rollers may be used, but I prefer the mode above described by me. Having thus reduced the tubes by passing them through a succession of grooves in rolls—and the kind of rolls which I prefer to use are those shown by fig. 1 of the accompanying drawings—I next proceed to withdraw the mandrel, which I effect in the following manner: I pass the tube on the mandrel from the rolls to a machine containing two, three, or more rolls. See figs. 1 z, 2 z, 3 z.

Fig. 1 z is a drawing of three-roll machine; A is a front view; B is a side view; c is a plan or horizontal view of the machine. *aaa* is the framing; *bbb* are the rolls; *ccc* are peg-pulleys, by means of which the rolls are driven; *dd* is an endless chain, or belt, working on the peg-pulleys, by which means the rolls are driven; *ee* are friction-pulleys, over which the chain or belt runs, to tighten it, as circumstances may require; *ff* are metal wheels, used in connection with the rod or shaft; *g* to move backwards and forwards one of the rolls *b*, so as to

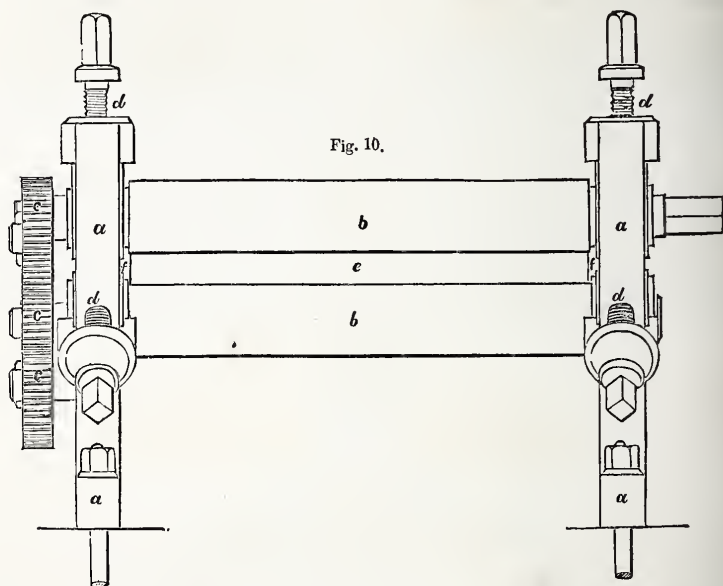


Fig. 10.

give ease to the tube on the mandrel, while it is pushed further between the rollers *bbb*, so as to cross-roll the tube on the mandrel; that is, to roll the tube a portion at a time, in lieu of having the rolls the full length of the tube; *g* is the rod or shaft carrying the wheels *ff*, which move the rolls *b* backwards and forwards; *h* is a cross-shaft with working wheels, to give motion for tightening and slackening the friction-pulley, while the roll *b* is being moved backwards and forwards; *L* is the driving-wheel (or a crank may be used), by which the rolls are set in motion; *i* are adjusting-pins, by which the rolls *bbb* are set to operate

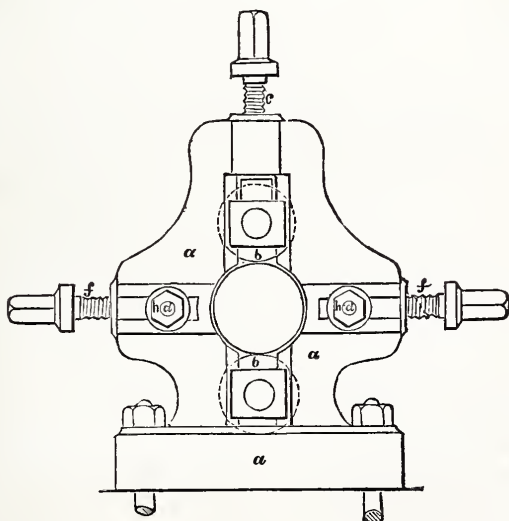
on the various-sized tubes; *j* is the aperture or space between the rollers, when the tube on the mandrel is placed for the purpose of being cross-rolled by the rolls *bbb*; *k* is the handle or crank by which *g* is turned, to move backwards and forwards the roller *b*: this may either be worked by power or hand. Roll *b*, 1, is made to move up and down, so as to be adjusted to the other rolls.

Fig. 2 z is a drawing of a three-roll machine, with the rolls at angles, so as to form a circle in the centre. *D* is a front view, *E* is a sectional view, and *F* is a side view; *aaa* is the frame-work; *bbb* the rolls; *cccc* are toothed wheels,

as shown on the drawings for working the rolls *bbb* (but I prefer to work them in the same manner as described by drawings, fig. 1 z, and which are made to slide in their journals to enable the rolls to be adjusted to any sized tube); *d* are adjusting-pins, by which the rolls *bbb* are set in their proper positions, to accommodate any sized tube that may be required to be cross-rolled, either to loosen it on the mandrel or make the tube perfectly straight and cylindrical, and regulating and equalizing the thickness of the metal throughout; *e* is the opening or space between the rolls, into which the tube on the mandrel is placed; *f*, the blue line, represents the tube between the rolls.

Fig. 3 z is a drawing of a two-roll machine, by which the tube on the mandrel may be released (but I prefer to use the machine as described in the drawing, fig. 1 z); *G* is a front view; *H* is a plan or horizontal view; *I* is a side view; *aaaa* is the frame-work; *bb* are the two rolls; *cc* are the adjusting-pins to the rolls; *dd* is a cross-bar in front of the rolls, on which are placed two sliding-stops *ee*, to fix against each end of the mandrel, while the rolls are operating on the tube, the mandrel projecting at each end beyond the tube, which has been rolled upon it; *ee* are the two stops to fix against the mandrel, as before described; *ff* are the two adjusting-screws or pins, by which the stops are regulated; *hh*

Fig. 11.



are the two screws and nuts, by which the cross-bar *d* in the frame *a* is moved nearer to and further from the rolls; *gg* are two stops placed on the frame on the reversed side of the rolls, as steadying blocks to the mandrel; *ii* are the adjusting-pins to the stops *gg*, by means of the several sorts of rollers just described. I cross-roll the tube; this has the effect of sufficiently enlarging the diameter of the tube, and releases or eases it upon the mandrel, so that the mandrel can easily be withdrawn, either

by a pair of tongs or pliers, by means of a draw-bench, or otherwise, without difficulty, or without in the slightest manner injuring the tube. The mandrel may be made in compartments, so as to facilitate the withdrawing it from the tube; but I prefer a mandrel all in one piece, whether taper or parallel, but it is not necessary that it should be solid, as hollow tubes as mandrels for large diameter tubes will be found to answer very well. If the tube should be slightly too large in its diameter from its cross-rolling, it

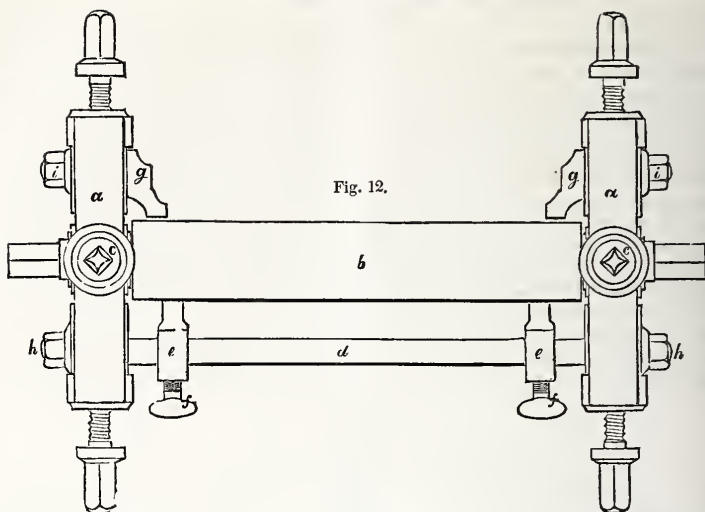


Fig. 12.

can be passed once through a hole, die, or draw-plate, or through a groove in the rolls, the hole being of the exact external diameter of the tube required. If the rolls for cross-rolling are of a greater length than about four or five feet, as shown in the drawings (fig. 1 z), they should be slightly stayed, or supported, in places to prevent them springing. This may be done by having some soft sub-

stance on the top of the support, such as leather well oiled, or other soft material. It will not require any very great pinch or pressure to cross-roll the metal sufficiently to ease it on the mandrel. A tube may be eased by placing it on a flat piece of iron, or other hard substance, and another flat plate of iron brought to bear upon it, and rolled backwards and forwards in the same manner as iron

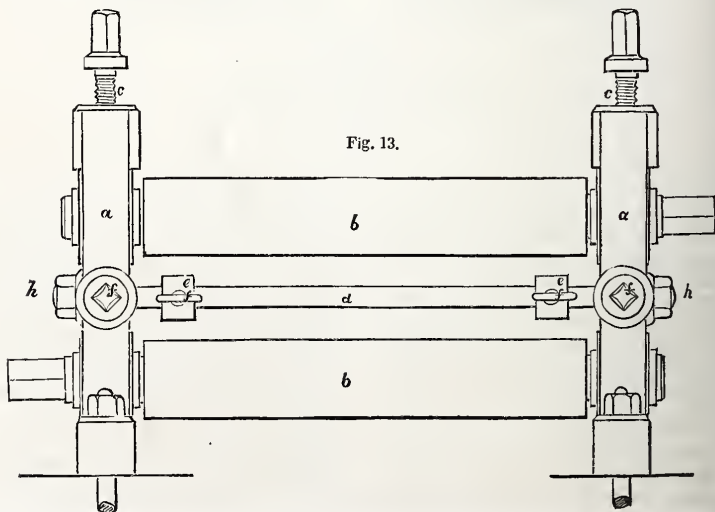


Fig. 13.

tubes are now straightened; but the mode of cross-rolling, which I prefer to use for this purpose, is a machine consisting of three rolls (see fig. 1 z), which may be made three, four, five, or six feet long, as may be found most suitable; and by movable geer, one of the said rolls may be made to play backwards and forwards, as shown in drawing (fig. 1, z). By this means the tube on the mandrel may be moved forward in the rolls with ease and at pleasure, so as to cross-roll the tube, a portion at a time, without any fear of the rolls springing: the strength of the rolls and machinery required will depend upon the work it has to perform. Tubes either rolled or drawn upon a mandrel in a cold state may be released by the means of cross-rolling, or by the other modes herein described; and the mode of working the rolls may be varied from those shown in the drawings, not confining myself to any particular mode of working or driving the rolls.

BARNUM'S IMPROVEMENT IN MACHINES FOR MAKING FELT AND HAT BODIES.

From the Specification of the Inventor, Daniel Barnum, of Philadelphia.

I HAVE invented and applied to use new and useful improvements in machinery for opening and suspending fibrous materials in the air surrounding an exhausted and perforated former, and also for hardening the fibres by a combination of the means for producing a steady current of numerous small fine jets of water upon them, and thus commencing the felting process while they are held to and upon the cone by the pressure of air, caused by the currents passing into the exhaust, dispensing with the use of felted or fulled cloth, or outer cones, for the purpose of making pressure upon the fibres preparatory to the suspension of the pressure of the air; the whole operation being performed before the cone and fibres are removed from the exhaust.

I will illustrate the nature of my invention by remarking, that long experience has proved the small wire picker which is universally used in the common fur-blower, to be the best means or instrument for opening the fibres of fur, and that the arrangement of the common fur-blower consists of a feeding-

apron, feeding-rollers, and a picker with numerous small wire teeth, placed within a chamber having an aperture under the picker for the admission of a current of air to aid in throwing the fibres into the chamber. All attempts to construct a machine for making hat bodies by combining one or more sections of the common fur-blower with the perforated exhausted cone, have hitherto failed, for the reason that the small wire teeth of the picker will not generate a current of air sufficient either in volume or velocity to suspend the fibres and to carry them through a chamber on to a perforated cone—distributing them through an aperture of the *form* and *size* of the cone, as is the case with all chambers or trunks heretofore known. Therefore the necessity for a strong current of air has hitherto caused the best means for opening the fibres to be abandoned, and other means for producing a sufficient volume of air to be substituted—for this purpose a fan without a casing, the wings of which act as a beater to remove the fibres from the cards, and to suspend them in air, was used and patented in England in 1833, and in 1840 the same inventor, T. R. Williams, made an application to the U. S. Patent Office, in which application a machine was described (but not claimed as invention) having a feeding-apron, feeding-rollers, a large picker cylinder with large spikes for teeth, and a chamber with an aperture under and back of the picker, for the admission of a current of air, to aid in throwing the fibres through the chamber on to a perforated exhausted former placed at the outlet of the chamber, which is of the size and shape of the former (see fig. 2 of the drawings of said Williams' patent). This machine is described as applicable to various kinds of manufacture; and in the cancelled part of the specification, it is referred to, in connection with forming hats and other irregular forms, with the remark that when irregular forms are "placed in the situation of the cylinder *i*, it is not necessary to inclose the former in casing, as shown in the preceding figures," 1, 2, 3.

In 1846 a patent was granted to H. A. Wells, for improvements upon this and other machines for making hats, which he declares to be applicable to "any shape or configuration," by substi-

tuting the required former, and changing the chamber and hood to correspond: in this machine, a brush, so arranged as to generate a strong current of air, is substituted for the large cylinder in Williams' machine, and Wells' improvements of the inclined aprons and hinged hood and flap are added to the chamber. This patent also extends to the process, the patentee declaring that his invention consists in covering the bat with felted or fulled cloth, the object of which is to make pressure upon the fibres to hold them preparatory to the suspension of the pressure of the air, caused by the exhaust, and while they are immersed to harden. Wells' improvement in the process, therefore, consists simply in the *addition of the cloth to Williams' application of the outer pressure or forms*, for the same purposes of making pressure to hold the fibres while they are immersed.

My improvements are contradistinguished from all these in various important particulars. *First*, I use the best known means for opening and separating the fibres of fur; to wit, the small wire picker of the common fur-blower, arranged and operated in the ordinary way—which has never been successfully used in a hat machine before—by which means I have effected a great improvement in the perfection with which the fibres are separated, and in the consequent evenness and beauty of the hat body when completed.

Second. For the purpose of concentrating and suspending the fibres in the air surrounding the perforated cone or former, I have combined with the chamber of the common fur-blower, into which the fibres are thrown by the picker, a small exhausting and suspending fan, which, by exhausting the chamber, draws the fibres into itself, and at the same time suspends them in the air surrounding the perforated cone in tangents through a small opening in its own easing.

Third. The opening through which the fibres are suspended is adjustable as to its position in the circle, as the casing is so constructed as to have a vibrating motion around the centre of the fan, by which means the lines or tangents to the circle, when drawn through said opening, and in which the fibres are suspended, may be made to embrace any portion of the cone at pleasure, thus securing perfect control over the distribution of the

fibres, a desideratum not heretofore attained: the means which have been patented for that purpose being abandoned in practice.

Fourth. Instead of placing the perforated exhausted cone, or other former, just in front of the opening in the casing, as is done in the machines referred to above, for the purpose of receiving the fibres as they leave the aperture of the chamber which directs them on to the cone or other former, I place my exhausted cone at such distance as will allow the fibres to radiate in the lines or tangents in which they are thrown from the wings of the fan on to the desired portions of the cone, according to the positions in the circle of the fan, in which the delivery opening, or aperture in the casing is placed, there being no chamber, or trunk, or tunnel, or spout, between the suspending instrument, the fan, and the cone, to direct or in any way to control the fibres after they are suspended by the fan.

Fifth. Heretofore it has been indispensably necessary to apply some means to the fibres upon the cone, to hold them preparatory to the suspension of the pressure of the air, in order to remove the cone and bat, to harden it, for which purpose Williams applied outer forms, and Wells felt cloth applied in a particular way, and also with outer forms; instead of which I harden the bat while under the pressure of the air over the exhaust, using for that purpose a combination of means never before known.

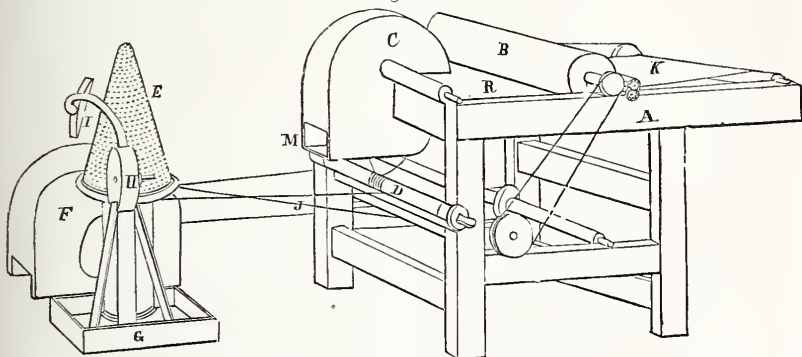
In the accompanying drawings, fig. 1 is a perspective representation of the machine in combination with a perforated exhausted cone, or former, and also with the means for hardening and commencing the felting process over the exhaust, preparatory to the suspension of the pressure of the air, and the removal of the hat body from the cone; and fig. 2 is a bird's-eye perspective view of the chamber, exhibiting the interior of the same, with the openings in the fan, the partition, and picker, the top or cover being removed for that purpose, as shown in fig. 3. The letters in each figure refer to the same parts.

In figs. 1 and 2, A represents the frame, with the picker B, arranged and combined with feeding-rollers and apron, as seen at K, fig. 1; and also with a chamber

r, figs. 1 and 2, with an aperture for the admission of air under the picker; the whole of the parts being arranged and operated relatively and collectively, and for the same purposes, as those described by Thos. R. Williams, in his application for a patent in 1840, except that his chamber extends to, and conducts the fibres on to the perforated exhausted former, or cylinder i, as de-

scribed and shown in his specification and drawings; while in my machine the fibres are allowed to fall into the chamber, from which they are taken by the currents of air which are caused to pass from the aperture under the picker, through the chamber into the fan c, which currents are induced by the exhaust action of the fan in receiving its supply of air, said currents being suf-

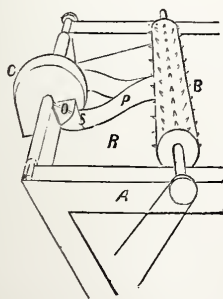
Fig. 1.



ficient in volume and velocity to carry the fibres into the fan, and to suspend them in the air, by which means they are concentrated within the fan-casing, from which they are suspended in the air, through the small square aperture or opening M, fig. 1, in lines forming tangents to the circle made by the fan. These lines or tangents, when drawn through said aperture M, are made to embrace any portion of the cone or former

ture as shown in the drawings at D, fig. 1, and also in the model; or the position of the aperture M may be changed by having that portion of the casing only adjustable which contains it, or the same results substantially may be obtained by allowing the casing and aperture to be stationary or permanent, and the cone or former adjustable vertically; thus, by raising or lowering it, any portions of its surface may be brought within the ranges or tangents, so that a

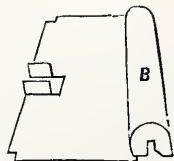
Fig. 2.



e, fig. 1, at pleasure: this may be done by making the whole casing adjustable so as to change the position of the aper-

ture as shown in the drawings at D, fig. 1, and also in the model; or the position of the aperture M may be changed by having that portion of the casing only adjustable which contains it, or the same results substantially may be obtained by allowing the casing and aperture to be stationary or permanent, and the cone or former adjustable vertically; thus, by raising or lowering it, any portions of its surface may be brought within the ranges or tangents, so that a perfect control over the distribution of the fibres is attained, without either chamber, trunk, hood, or flap to direct them after they are suspended in the air, surrounding the exhausted former, or between it and the fan c. The perforated or exhausted former E is placed in front of the aperture M, about from two to three feet distant from it, or at such distance as will allow the lines or tangents, as they radiate from the wings of the fan, to embrace from one-half to two-thirds more or less of the height of the former; this will allow of

Fig. 3.



a sufficient change in the relative positions between the aperture *M* and the former *E*, to cause the fibres to be drawn by the exhaust of the fan *F*, upon any portion of the former *E*, to give the requisite proportions of the fibres upon any part of the hat body as desired.

The cone or former, *E*, has a slow revolving motion, as seen at *J*, for the purpose of presenting in its revolutions the entire surface of the former to the ranges or tangents in which the fibres are suspended; *F*, fig. 1, is an exhausting fan having a rapid motion for the purpose of producing a partial vacuum under the perforated cone *E*; *G*, fig. 1, is a square box forming a reservoir of water, which may be kept hot by steam, or otherwise; the exhausted former is placed over this reservoir, and the two are so arranged that a supply is furnished to wet the hat, and the surplus returned to the reservoir, so that no water or fuel to heat it is lost. *H*, fig. 1, is a rotary force-pump with a suction-pipe connected with the water; *I*, fig. 1, is a perforated sprinkler and flexible rubber hose attached to the pump *H*, the object of this part of the arrangement being to produce a steady current of numerous fine jets of hot water to wet the fibres on the former over the exhaust, and to commence the hardening and felting process by the combination of currents of air and water with the fibres. These combinations produce new and beneficial results, and they are contradistinguished from all known modes of wetting, and hardening, and commencing the felting process, inasmuch as the currents of air and water, when they come in contact with the fibres, and in their passage through them into the exhaust, not only hold the fibres and wet them, thus dispensing with the trouble and liability to damage resulting from the necessity hitherto existing of applying "some means" to hold the fibres "preparatory to the suspension of the pressure of the atmosphere," and of removing them, but they produce an actual working together of the fibres under the pressure and motion caused by their rapid and combined action in passing through the fibres into the exhaust, so that the felting process, which can only be produced by motion of the fibres in contact, is actually commenced previous to the application of mechanical pressure or manipulations,

either by hand or machinery. After the currents of air and water have performed their duties as above described, of holding the fibres, of wetting, and by their combined action and motion commenced the hardening and felting process, it becomes necessary that the water should be taken away to prevent washing the hat body. This duty is also performed by the current of air which is continuous, and which, as soon and as fast as the surplus water passes through the fibres, carries said surplus through the perforations into the exhaust, thus securing the perfection of the operation, and the realization of the practical benefits due to these improvements: in fig. 2, *P* shows the triangular-shaped partition which conducts the fibres from the picker to the opening in the fan-casing *S*, through which opening is seen one of the wings of the fan *O*. The relative position of the fan *C* and cone *E* with the chamber *R* and picker *B* may be changed so as to present only one side of the fan to the chamber, in which case there would be but one opening through the casing and the triangular partition would not be required, and the fibres would be concentrated within the fan through one opening, and suspended at right angles to the line of motion of the picker, the perforated former being placed in the same relative position with the aperture *M*, as before, the results and operations would be substantially the same; *R*, fig. 1, shows the chamber with the top or cover *B*, fig. 3, in its place; and *R*, fig. 2, shows the interior of the chamber, the cover *B*, fig. 3, being removed for that purpose.

The success of my improvements in the process of wetting and hardening, and commencing the felting of the hat body, is entirely due to the discovery which I have made, that the currents of air not only hold the fibres while they are wet, but that they also aid the water in penetrating and saturating the fibres, and that they also perform the further great and important duty of removing the surplus water, which would otherwise accumulate under the fibres, and wash them away. This would of course defeat the whole operation; but with this duty performed, the result is eminently beneficial and important, both in the facility and ease of operation, as well as in the value of the hat body when finished,

in consequence of the perfection of the work. This perfection is secured from the perfect control which the operator has over the distribution of the fibres, and from the absence of any and all liability to damage in the application of the cloth and outer pressure to hold the fibres, to immerse them, and in their removal after hardening.

As before remarked, these improvements are contradistinguished from all other modes known of opening and suspending fibrous materials in the air, as well as from all known processes for hardening or wetting them upon the cone or former. No chamber, or trunk, or tunnel, gradually changed in form to a delivery aperture of the shape of the former, or near it in size, but higher, as was used by Williams in 1840, and by Wells in 1846, to concentrate the fibres, or to direct them on to the cone or former after they were suspended in the air, is used. Nor is there any hood or flap to aid in the distribution of the fibres upon the cone or former used, as claimed by Wells in 1846. Nor is there any aperture nearly corresponding in shape and size with the former used, as described by Wells in 1846, and without which it would be impossible to form a hat body on his machine—Wells declaring that his aperture must be higher than the cone; nor is it necessary that the aperture *M*, which I use, should be changed to suit any other form in order to form any other shape or size—a change which Wells declares in his patent to be necessary, when the shape or configuration is to be changed; nor is my former placed near the aperture, as is done in Wells' machine, and which cannot be dispensed with; nor, indeed, can it be placed so with success, as the absolute necessity exists of its being placed at such distance as will allow the fibres to radiate in the lines or tangents, so as to embrace a portion of the former much greater than the aperture *M*, through which the fibres are suspended. These several differences between these improvements and others being clear and distinct on a comparison of the machinery for forming the hat body, without referring to the small wire picker to open the fibres in the best manner, as compared with the large picker and brush, to produce a current of air, sufficient to suspend the fibres

through a large chamber, gradually changed to the size of the former, as was done by Williams and Wells.

And in relation to the wetting and hardening process, no outer cones, or outer cones and cloth, as used by Williams in 1840, and by Wells in 1846, to make pressure preparatory to the suspension of the air, to hold the fibres, while they are immersed to harden, are used. Nor is the cone and hat body, after the cloth is applied to make pressure to hold the fibres, immersed to harden, as claimed by Wells in 1846.

The exhausting and suspending fan *C*, with its casing and aperture *M*, constructed, arranged, and operated substantially as, and for the purposes hereinbefore particularly described, in combination with the picker *B*, chamber *R*, perforated exhausted former *E*, and exhaust fan *F*, arranged substantially as described and shown, by which arrangements and combinations the several parts or their equivalents perform their several and combined functions in a better manner and produce better results than has been heretofore attained, without any chamber, trunk, or tunnel, or any other means to control the fibres after being suspended in the air by the fan, or between the fan and perforated exhausted cone or former substantially as described and shown.

I also claim the combined action of the currents of air and the currents of numerous jets of hot water in the hardening or wetting process, the currents of air performing the triple duty of holding the fibres on the former, and of aiding the water to penetrate the hat body and at the same time to carry the surplus water through the perforations into the exhaust, thus effectually preventing injury to the hat body from the accumulation of the surplus water to wash it, while the wetting or hardening process is greatly facilitated, and the perfection of the work is secured: the whole process being accomplished by the combination of the several parts named, or their equivalents, for producing the currents of air and water, with the perforated former over the exhaust, in the manner and for the purposes substantially as herein described and shown.

The effect of these improvements is the production of a machine combining

the best means for opening fibrous materials, and suspending them in the air surrounding a perforated and exhausted former, and also of a new combination of means for hardening the fibres and completing the process without removing the hat, or applying any pressure preparatory to the suspension of the pressure of the air, by which means a great improvement is effected, as well in the forming of the hat, and in the process of hardening, as in the facility of operation: the whole being by combination of machinery heretofore unknown.

ERICSSON'S PATENT CALORIC ENGINE.

THIS is a scheme which Mr. Ericsson tried some years since, but which, at the time, was not successful; and his attention has been directed to removing those practical difficulties which meet the experimentalist on this subject at every turn. An engine of apparently 6 or 8 horse-power has been placed by him in the Exhibition building, and to obviate the difficulty of working it within the building, owing to the regulations as to fire, &c., one of 100 horses' power is now being constructed in the United States for exhibition, which was intended to be erected near the Exhibition boiler-house, and set to work, to afford an opportunity of acquiring some experience of its powers and economy. The invention has been secured in England in the name of Captain Dunn, Mr. Ericsson's representative.

A moment's reflection will show that there is a *possibility* of effecting an immense saving on our present method of employing coal as a generator of power. In our most economical expansive engines, we *recover* nothing of that which we employ. The heat required to convert the water into steam is delivered by the air-pump, diluted, so to speak, with so much cold water, and the problem is, to concentrate that heat and render it again available for generating steam. Whether that problem can ever be solved, whilst water is used as a medium, it is impossible to predict. The gases appear to offer a better chance of success, and accordingly Mr. Ericsson employs the expansive force of heated air in his engine instead of steam. The engineer will perceive at a glance that the arrange-

ment described is not such as would effect the greatest economy. The cylinders would doubtless be made double acting, more especially as the engine is essentially a low-pressure one, and the whole arrangement modified to save room and weight.

The principal novelty appears to consist in the employment of a condenser, which, when saturated with heat, is used as a regenerator or boiler, until it is sufficiently cool to act again as a condenser. It is proposed to have two of these condensers, to be used alternately, although we think it possible that in practice it will be found that there will be certain points of temperature between which these vessels will be too hot for condensers, and not hot enough for generators. But this may be met by increasing the number of these vessels, and using them alternately. Probably, to lower their temperature quick enough, in order to convert them into condensers, a small jet of water might be used; whilst, by having a succession of condensers, the air would first pass through the hottest, and so on in succession, till it was deprived of its remaining heat by the coolest of them; a reverse action would take place with the generators. But leaving these suggestions, which have probably occurred to the inventor equally with ourselves, we will proceed to quote the specification before us.

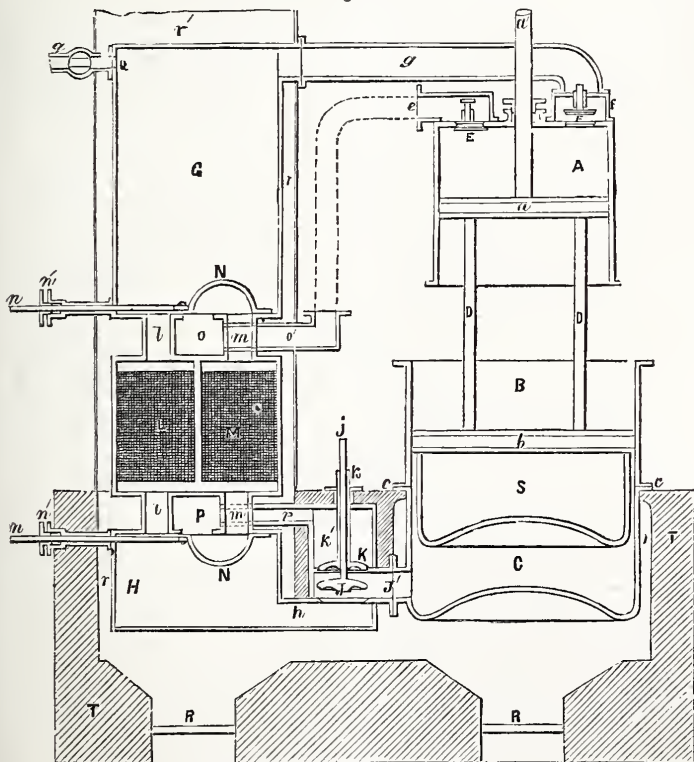
The invention consists in producing motive power by the application of caloric to atmospheric air or other permanent gases or fluids susceptible of considerable expansion by the increase of temperature. The mode of applying the caloric being such, that after having caused the expansion or dilatation which produces the motive power, the caloric is transferred to certain metallic substances, and again retransferred from these substances to the acting medium at certain intervals, or at each successive stroke of the motive engine, the principal supply of caloric being thereby rendered independent of combustion or consumption of fuel; accordingly, whilst in the steam-engine the caloric is constantly wasted by being passed into the condenser, or by being carried off into the atmosphere, in the improved engine, the caloric is employed over and over again, enabling me to dispense with the employment of com-

bustibles, excepting for the purposes of restoring the heat lost by the expansion of the acting medium and that lost by radiation, also for the purpose of making good the small deficiency unavoidable in the transfer of the caloric.

Having thus stated the object and general character, I will now proceed to describe the structure of the improved engine for producing motive power, reference being had to fig. 1. A and B are two cylinders of unequal diameter, accurately bored and provided with pistons

a and *b*, the latter having air-tight metallic packing rings inserted at their circumferences. I call A the supply cylinder, and B the working cylinder, *a'* piston-rod attached to the piston *a* working through a stuffing-box in the cover of the supply cylinder. C is a cylinder with a spherical bottom attached to the working cylinder at *cc*; I call this vessel the expansion heater. D D, rods or braces connecting together the supply piston *a*, and the working piston *b*. E is a self-acting valve opening inwards to the supply cyl-

Fig. 1.



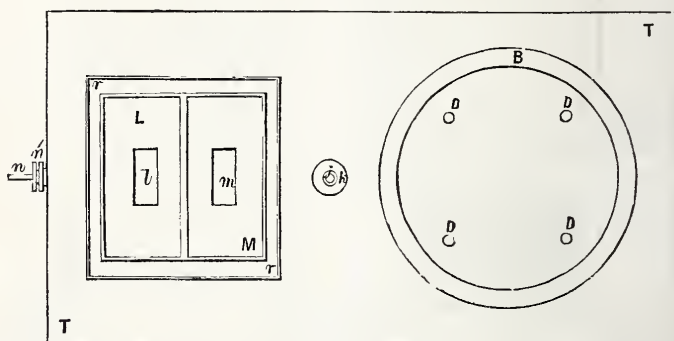
inder; F, a similar valve, opening outwards from said cylinder, and contained within the valve-box *f*. G is a cylindrical vessel, which I call the receiver, connected to the valve-box *f* by means of the pipe *g*. H, a cylindrical vessel with an inverted spherical bottom; I call this vessel the heater. J, a conical valve sup-

ported by the valve-stem *j*, and working in the valve-chamber *j'*, which chamber also forms a communication between the expansion heater C and heater H, by means of the passage *h*. K is another conical valve, supported by the hollow valve-stem *k*, and contained within the valve-chamber *k'*. L and M, two vessels of cubical

form filled to their utmost capacity, excepting small spaces at top and bottom, with disks of wire net or straight wires closely packed, or with other small metallic substances, or mineral substances, such as asbestos, so arranged as to have minute channels running up and down. I call these vessels, *L* and *M*, with their contents, regenerators. *l l*, *m m*, pipes forming a direct communication between the receiver *G* and the heater *H*, through the regenerators. *N N*, two ordinary slide-valves, arranged to form alternate communications between the pipes *l l* and *m m*, and the exhaust chambers, *o* and *p*, on the principle of the valves of ordinary high-pressure steam-engines; *n n*, valve-stems working through stuffing-boxes *n' n'*; *p*, pipe communicating between the valve-chamber *k'* and exhaust-chamber

p; *o'*, pipe leading from exhaust-chamber *o*; *q*, pipe leading into the receiver *G*, provided with a stop-cock *q*. *R R*, fireplaces for heating the vessels *H* and *C*; *rrrr*, flues leading from said fireplaces, and terminating at *r'*. *s*, a cylindrical vessel attached to the working piston *b*, having a spherical bottom corresponding to the expansion vessel *c*. This vessel, *s*, which I call the heat-intercepting vessel, is to be filled with fire-clay at the bottom, and ashes, charcoal, or other non-conducting substances towards the top, its object being to prevent any intense or injurious heat from reaching the working piston and cylinder. *T T*, brick-work or other fire-proof material surrounding the fireplaces and heaters. Fig. 2 represents a sectional plan of fig. 1.

Fig. 2.



Before describing the operation of the improved engine, it will be proper to observe that the piston-rod *a'* only receives and transmits the differential force of the piston *b*, viz., the excess of its acting force over the reacting force of piston *a*. It will also be proper to observe that this differential force imparted to said piston-rod may be communicated to machinery by any of the ordinary means, such as links, connecting-rods, and cranks, or it may be transmitted directly for such purposes as pumping or blowing. I have further to observe, that the conical valves *K* and *J* may be worked by any of the ordinary means, such as eccentrics or cams, provided the means adopted be so arranged that the valve *K* will commence to open the instant that the piston *b* ar-

rives at the full up-stroke, and be again closed the instant the piston arrives at full down-stroke, whilst the valve *J* is made to open at the same moment, and to close shortly before, or at the termination of the up-stroke. In like manner, the slide-valve *N'* is to open and close as the piston *b* arrives respectively at its up and down stroke, similar to the slide-valve of an ordinary high-pressure engine.

Having thus described the construction of the engine, I will now proceed to describe the manner in which the same is to be put into operation. Before starting, fuel is put into the fireplaces *R R*, and ignited, a slow combustion being kept up until the heaters and lower parts of the regenerators shall have been brought to a temperature of about 500°.

By means of a hand-pump, or other similar means, atmospheric air is then to be forced into the receiver *G* through the pipe *Q*, until there is an internal pressure of some 8 or 10 pounds to the square inch. The valve *J* is then to be opened, as shown in the drawing; the pressure entering under the piston *b* will cause the same to move upwards, and the air contained in *A* will be forced through the valve *F* into the receiver. The slide-valves *NN* being, by means of the two stems *nn*, previously so placed that the passages *ll* are open, the air from the receiver will pass through the wires in *L* into the heater *H*, and further into *c*, the temperature of the air augmenting, and its volume increasing as it passes through the heated wires and heaters. The smaller volume forced from *A* will, in consequence thereof, suffice to fill the larger space in *c*. Before the piston arrives at the top stroke, the valve *J* will be closed, and at the termination of the stroke the valve *K* will be opened; the pressure from below being thus removed, the piston will descend, and the heated air in *c* will pass through *k'p* and *m* into the regenerator *M*, and in its passage through the numerous small spaces or cells formed between the wires, part with the caloric, gradually falling in temperature until it passes off at *o'*, nearly deprived of all its caloric. The commencement of the descent of the piston *a* will cause the valve *F* to close and the valve *E* to open, by which a fresh charge of atmospheric air is taken into the cylinder *A*. At the termination of the full down stroke, the valve *K* is closed and the valve *J* again opened, and thus a continued reciprocating motion kept up. It will be evident, that after a certain number of strokes the temperature of the wires or other matter contained in the regenerators will change; that of *M* will become gradually increased, and that of *L* diminished. The position of the slide-valves *NN* should, therefore, be reversed at the termination of every fifty strokes of the engine, more or less, which may be effected either by hand, or by a suitable connection to the engine. The position being, by either of these means, accordingly reversed to that represented in the drawing, the heated air or other medium passing off from *c* will now pass through the partially cooled wires in *L*, whilst the cold medium

from the receiver will pass through the heated wires of *M*, and on entering *H* will have attained nearly the desired working temperature. In this manner the regenerators will alternately take up and give out caloric, whereby the circulating medium will principally become heated, independently of any combustion, after the engine shall have been once put in motion.

It is particularly worthy of notice, that the relative diameter of the supply and working cylinder will depend on the expansibility of the acting medium employed; thus, in using atmospheric air or other permanent gases, the difference of the area of the pistons may be nearly as 2 to 1, whilst in using fluids, such as oils, which dilate but slightly, the difference of area should not much exceed one-tenth. I have next to notice that in employing any other medium than atmospheric air, it becomes indispensable to connect the outlet pipe *o'* and the valve-box *e* of the outlet valve *E*, as indicated by dotted lines in the drawing, these dotted lines representing the requisite connecting-pipe. The escaping air or fluid at *o'* will, when such a connecting-pipe has been applied, furnish the supply cylinder independently of other external communication, and the acting medium will perform a continuous circuit through the machine under this arrangement; the operation being in other respects as before described. It is evident that the several parts composing the improved engine may be arranged in various ways, and the external form thereof may be greatly changed, whilst its principle of operation remains substantially as I have ascertained and described. It is also evident that the working cylinder may be placed horizontally or otherwise, and that it may be made double acting; and that a heat-intercepting vessel may be applied at each end of the working piston, as also an expansion heater at each end of the working cylinder. I do not, therefore, confine myself to the exact form represented in the drawing, but I claim as the invention the substantial features of the devices I have described as new, and by which I secure great and beneficial results.

Claims.—1st. I claim the structure which I call the regenerator, by which I effect a transfer of the caloric contained

in the air, or other circulating medium that passes off from the working cylinder to a series of disks of wire-net, or to other minute metallic or mineral substances, for the purpose of being again retransferred to the air or other circulating medium that enters the working cylinder, whether said structure be so arranged that the metallic or mineral substances are made to take up and again return the caloric at each successive stroke of the working piston, or whether it is so arranged that the transfer and retransfer of the caloric takes place at intervals, or whether said structure is arranged in any other manner for the purpose of accomplishing substantially the purposes hereinbefore mentioned.

2d. I claim the combination of the expansion heater with the working cylinder, by which the fall of temperature consequent upon the expansion of the air or other circulating medium during the upward movement of the working piston becomes restored, and by which also the force of said piston becomes augmented beyond what it would be if the accession of caloric effected by the expansion heater did not take place.

3d. I claim the heat-intercepting vessel attached to the working piston, by which any injuriously high temperature is prevented from reaching the packing of said piston, and by which also the very desirable end is attained of presenting at all times surfaces of uniform high temperature to the acting medium under the working piston.

4th. I claim the inverted position and open ends of the working and supply cylinders, as represented in the drawing.

5th. I claim the direct attachments of the working and supply pistons, by which not only the acting and reacting forces may be uniformly distributed over the area of each piston, but by which also the entire differential power of the working piston is rendered available, less only the friction of the packings.

BLOOMING IRON.*

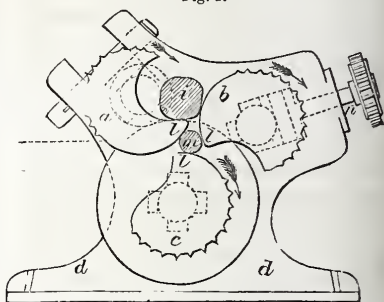
THE following paper by Mr. Joseph Beasley, of Smethwick, was read before the Institution of Mechanical Engineers.

* From the London Artisan.

The purpose of this machine, which has been invented and patented by Mr. Jeremiah Brown, is to perform the process of Blooming the Iron from the Puddling Furnace, which is usually done by hammering, and in some instances by squeezing; the object being to squeeze out the cinder from the puddled ball, and to compress the iron into a form ready for rolling into a bar, which is done at the same heat.

The machine is shown in fig. 1, and consists of three large eccentric rolls *a b c*, placed horizontally in the strong holsters *d d*, the centres of the rolls being arranged in a triangular position, and the bottom roll *c* nearly central between the two top rolls *a b*. These rolls all rotate

Fig. 1.



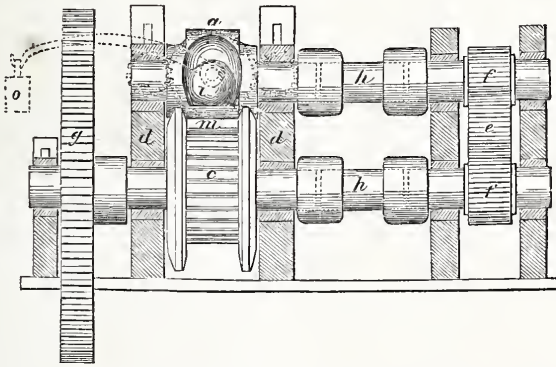
in the same direction as shown by the arrows, and are driven by a centre pinion *e*, working into three pinions of equal size, *f f f*, fixed on the roll spindles; in the present machine the driving power is applied direct to the bottom roll by means of the large wheel *g*, for the convenience of carrying the main shaft under the floor—but it could be applied to the centre pinion, if preferred. The rolls are cast solid with their journals like ordinary rolls, and are driven in the usual manner by coupling-boxes and spindles *h h*.

The roll-faces are 16 inches long, and the bottom roll has strong flanges at each end, 8 inches deep, between which the two upper rolls work; the object of these flanges is to upset or compress the ends of the bloom, as the iron in the operation is elongated, and the ends are forced against the flanges, which makes them square and sound, as shown by the specimen of a bloom exhibited to the meeting. The top roll *a* has a large hol-

low in which the puddled ball *i* is placed by the puddler; and this roll carries the ball round, and drops it into the space between the three rolls, as shown in fig. 2, this space being at that moment at its largest capacity. The three projecting points *k k k* of the rolls immediately impinge upon the ball, and compress it for-

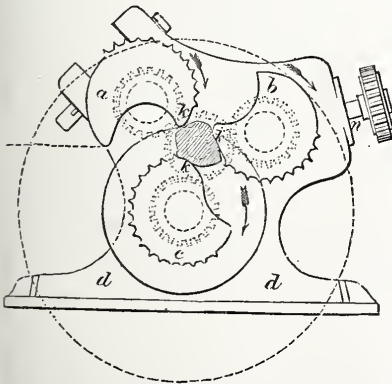
cibly on the three sides, and, giving a rotating motion to the ball at the same time, they have a very powerful kneading action upon the iron, squeezing out the cinder very effectually, which flows freely away, down each side of the bottom roll. The space between the rolls gradually contracts, from the eccentric or spiral

Fig. 2.



form of the rolls, thereby maintaining an increasing compression on the iron on all sides and the ends, until it is liberated by the points *l l l* simultaneously passing the bloom *m*, which falls down in the direction of the arrow, and is discharged

Fig. 3.



from the machine at the same moment that another ball is dropped in at the top of the machine. The projecting teeth on the surface of the rolls assist this action, by seizing hold of the iron and kneading into it as it rotates; and these teeth

gradually diminish in projection, the last portion of each roll being plain, and the bloom is consequently turned out in a smooth, compact form, as shown by the specimen exhibited. The space between the flanges of the bottom roll is widened for a short distance beyond the point *l*, for the purpose of allowing the bloom to drop out readily, and admitting the fresh ball.

A provision is made to prevent risk of breaking the rolls by any unusual size of ball being put in, by means of the two large triple-threaded screws *n n*, which bear upon the journals of one of the top rolls *b*; a small pinion on the head of each of these screws works into a large pinion fixed between them, which has a horizontal lever fixed to it, carrying a balance-weight *o* at the end; this weight causes a constant equal pressure on the roll, and in the case of any ball of extra size being put into the machine, the screws yield by turning back and lifting the weight to the extent that may be required, so that a large ball will be worked with the same pressure and in the same effective manner as the smaller sizes. A continual supply of water is run on to all the journals throughout the machine, which prevents any possibility

of the journals becoming hot, even when the machine is in constant work.

The advantages derived from this machine are:

1st. The *saving of time* effected in the operation, as the machine makes five revolutions per minute, and turns out five blooms in that time, and consequently each bloom is only 12 seconds, instead of from 60 to 80 seconds, the time required in the usual process of hammering being only about one-fifth or one-sixth of the time; the iron from the machine is therefore passed through the bar rolls at considerably greater heat than that from the hammer, and is consequently softer and better worked in that process.

2d. The *saving of expense in manufacture*, as the machine is self-acting, and requires no men to attend the working; whereas, the hammer requires an experienced hammer-man in all instances, and sometimes two, depending on the number of furnaces the hammer has to work for, and these men are entirely dispensed with by the machine being self-acting. An endless chain is also being added to the machine, working in an inclined direction from the lower side of the bottom roll, for the purpose of catching the bloom as it falls from the machine, and carrying it up direct to the bar-rolls without any manual labor. In consequence of the machine turning out five or six blooms in the same time that one bloom is completed by the hammer, it is capable of working for a much larger number of furnaces, indeed for as many furnaces as can be placed within a convenient distance for working. Another important advantage from this circumstance is, that the puddlers are never liable to be kept waiting for their turns, as is often the case where one hammer works for more than 8 or 10 furnaces; on the contrary, with the machine, the greatest number of furnaces that can be arranged to be worked by one machine will not be sufficient to employ it on the average more than one-quarter of its time, and consequently a very great margin is afforded for meeting the unavoidable irregularities in the supply of the balls from the several puddlers, which prevents the waste of iron and deterioration in its quality, that is caused when the puddler has to keep the iron back in

the furnace waiting for his turn with the hammer.

3d. The *saving of expense in tools*, which is very heavy where hammers are used; the hot iron being five or six times longer in contact with the hammer and anvil than with the machine, and the hot cinder out of the iron lying upon the anvil, instead of falling off constantly as it does in the machine; also the impossibility of applying a constant stream of cold water to the hammer as is done in the machine, cause the hammer and anvil to get so very hot, where a number of furnaces are working, that they wear out very rapidly, sometimes lasting only a week, and are always liable to break, as also is the helve. The loss of time in replacing a hammer or anvil, when it breaks, or fails during the working, is at all times attended with loss in the quantity and quality of the iron, from being kept back in the furnace after it is ready until the tools are replaced; and when the helve breaks, the stoppage becomes a serious evil. The expense of keeping the machine in repair cannot be ascertained at present from actual experience, as the present machine at the author's works is the only one that has yet been in regular operation for any length of time, and that only for the last four months; this machine is standing the work quite satisfactorily, and the only expense incurred since starting has been from an accidental breaking of one of the couplings soon after starting, through a defect of manufacture. An effective provision is made to prevent risk of breakage in the machine, by the driving-clutch being made proportionately very light, so as to give way before any other part can be injured, and this can be replaced in five minutes at any time, if broken. The annual extra expense in repairs, and extra power with a pair of hammers to do the same work, would probably amount to as much as the total first cost of the machine.

4th. The *saving of power*, with the machine, as the power is only exerted during one-fifth of the time required by the hammer, and during the greater portion of that time the power required in the machine is comparatively small, from the very soft and loose state of the ball, and the full power is not exerted until the revolution is nearly completed;

whereas with the hammer, the power absorbed is the same throughout the whole of the operation, as the same mass of the helve is lifted at each stroke of the hammer. Also less power is required in rolling the iron from the machine, in consequence of its greater heat.

5th. *Improvement in the quality of the iron*, in consequence of the cinder being more thoroughly squeezed out of the iron, from the enormous pressure to which it is subjected, and from the powerful kneading action of the rolls throughout the revolution of the machine whilst the iron is in a welding state, which unites the grain of the iron more effectually than can be done by the hammer. This action of the machine is *constantly* going on upon the iron, but in the other case the *greater portion* of the time is *wasted* in the lift and fall of the hammer, and this time is of great importance, as, the hotter and more fluid the cinder is, the more completely can it be squeezed out from the body of the iron. The action of the machine is clearly shown by the accompanying sectional model, and it will be seen that the ball is made to take a somewhat triangular form, by the pressure of the three rolls, and that every particle of the iron in its turn is, by the revolution of the ball, subjected to the kneading action of the rolls, and is thereby first pressed in towards the centre of the mass, and again squeezed outwards by the pressure that other particles are subjected to, thus giving great facility for the escape of the cinder from every part of the ball, and forcing it out in a more effective manner than the ordinary process of working a four-sided bloom under the hammer.

There have been other machines invented, on different principles, for the purpose of blooming iron by a process of *squeezing* instead of *hammering*, but the present machine is considered to possess important features of superiority, that enable it to surpass the hammer in the quality of iron produced, on account of the above-described action, which is peculiar to this machine; the certainty of the cinder constantly flowing freely away from the iron without risk of getting it lapped up in the bloom, and the perfectly uniform process that every bloom is subjected to, while the quality of the iron worked by the hammer depends entirely

on the amount of labor and care bestowed upon it by the hammer-man.

Mr. Beasley exhibited a working model of the machine, and various specimens of iron rolled from similar blooms made by the machine and by the hammer from the same heat of the puddling-furnace, to show the superiority of quality and greater purity from cinder in the iron made by the machine. Also specimens of a bloom from the machine and from the hammer, with one from the machine cut through the centre cold, to show the soundness of the iron.

Mr. Cowper showed a sectional model, full-sized, illustrating the kneading action upon the iron of the three spiral rolls, by the change that took place during revolution in the position of the different points of a circular flexible hoop, representing the ball of iron, which was compressed into the triangular space between the three rolls. He thought that, supposing the puddle-ball could be taken hold of by the hand, and squeezed like a wet sponge, that would be the most efficient way of separating the cinder; and the action of the machine resembled this process, by kneading the ball between the three revolving surfaces; but the hammer performed the operation by hammering all round the ball, on each side in succession. If the iron was tender, by rolling it between two surfaces, as in the other squeezers, it was torn open; but in this machine, with the three rolls, the iron is more supported, and is subjected to enormous pressure, and the cinder is more effectually squeezed out from the body of the iron.

Mr. Gibbons observed, he had seen the machine in operation at Mr. Beasley's works, and saw many blooms made by it, and all equal to the sample exhibited: he should say, that the specimens of iron produced were fair specimens of the iron made; and his impression was, that he never saw iron turned out more perfectly. The operation of the machine was very satisfactory; and it was important for the blooms to be all worked in a uniform manner, and made of even surface.

Mr. Siemens said, he had tried an experiment to ascertain the comparative power required to work the machine and the ordinary hammer, by taking the indicator diagrams exhibited to the meeting, of the power of the engine when working

without any load, and then the power when driving the machine alone, and when driving the hammer alone; the indicator diagrams were taken at various periods of the revolution of the machine, to ascertain the average power, as the power exerted at the commencement of the revolution appeared to be very small, and it was mainly concentrated at the last portion. The average power of the engine was increased about four horse-power, while the machine was working, and about six horse-power by the hammer; but as the former power was in action for only 12 seconds in the operation of blooming, and the latter was 60 to 80 seconds in action, the total comparative power in the two cases would be as 48 (4×12) to 420 (6×70), or as 1 to 9, showing the power absorbed by the hammer to be nine times as great as that by the machine. This, however, might require some correction, on account of the momentum of the engine fly-wheel, from some power being given out at the moment by its velocity being retarded; he could not detect any loss of velocity in the present case, but a more accurate measure might be obtained of any differential velocity, and he hoped to have an opportunity of making a more complete trial of the comparative power of the machine and the hammer.

The Chairman inquired, whether there was not danger that the machine would lap up more cinder in the iron than was usually the case with the common process of hammering?

Mr. Beasley said there was not any danger of it, and he considered it was impossible, from the action of the machine, that any cinder could be lapped up in the iron, as there was no possibility of a portion of the iron getting lapped over in the process, and inclosing some of the cinder in a pocket or hollow, which was, however, the case occasionally with the hammer.

Mr. Walker remarked, that there were traces of cinder in the specimens of iron from the machine, and he thought there must be some portions of cinder lapped up in the process. He did not think the machine would be so effective as the hammer in extracting the cinder from the ball.

Mr. Cowper said he had carefully observed the working of the machine, and

considered its action was very perfect. The iron was subjected to an enormous pressure, and he was decidedly of opinion that no cinder was lapped up in it. He did not mean to say that the machine produced better iron than the hammer, but it was at least quite as good.

Mr. R. Williams observed, that if iron was imperfectly puddled the hammer would knock it to pieces, and show the defect in the quality of the iron; but he thought the machine would roll the iron all up, whether good or bad. He was of opinion that, from the rolling action of the machine, the cinder would be lapped up in the iron.

Mr. Beasley said, it was found that if the iron was not properly worked, or it was "green" iron, it was shown at once by the machine tearing it to pieces, although in other squeezers it might still be wrapped up into a ball.

Mr. R. Williams considered the cost of the machine, and expense of keeping it in repair, would be an important consideration, and whether it would not be liable to accident and stoppage, from its complication, compared to the hammer. He thought the different sizes of balls would not be equally well worked, as they were with the hammer.

Mr. Beasley replied, that the machinery was precisely similar, and not more complicated than the ordinary rolls, and no more liable to go wrong. This machine had been working four months without accident, except one, which was from an accidental defect in the original make; and he considered it was decidedly less liable to stoppage and delay than the hammer. It was not intended to do away with the hammer altogether, but when larger sizes of iron were required, larger machines might be constructed for such a purpose. The machine was suitable for all the various sizes of iron in ordinary work by using the regulating screw.

Professor Hodgkinson said he had better acquaintance with the strength of iron than the process of manufacture; he had at first rather strong prejudices against the machine; he did not think it was exactly the right mode in which to get rid of the cinder, and it appeared to him likely to lap up some of the cinder; but he thought the objections he at first entertained were considerably lessened; the

samples of iron from the machine, he must say, looked remarkably well.

Mr. Cowper said he was, at first, much prejudiced against the machine; but his opinion was greatly changed since he had examined it in operation.

The Chairman observed, that the merit of the machine depended upon the relative quality of the iron produced, and there appeared a difference of opinion upon that subject. It was desirable that this point, as well as the cost of the different processes, should be ascertained, and laid before the Institution; and he therefore suggested that the inquiry and experiments should be further pursued, and the results reported to a future meeting.

RYDER'S PATENT FORGING MACHINE.*

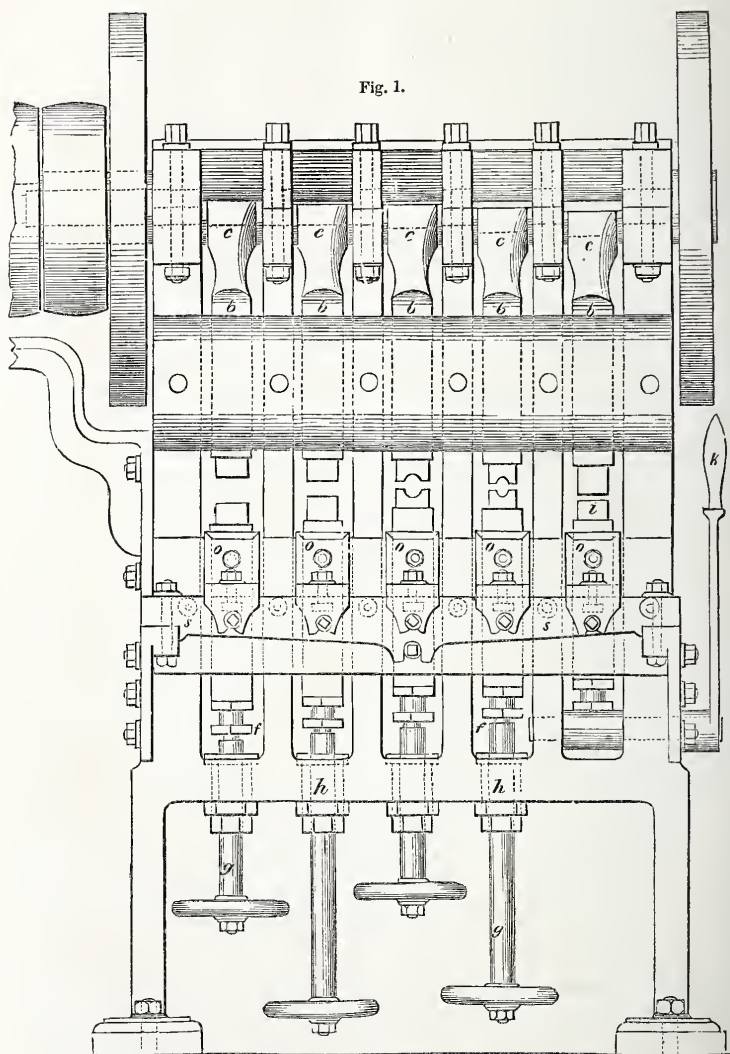
VARIOUS attempts have been made to supersede the costly hand-labor of the smith by machinery, but generally without success; a result which we believe may be attributed, in a great measure, to the projectors attempting too much. In practice, it will not do to feed iron in at one end of a machine and bring it out finished at the other. For bolts, rivets, and so forth, this forcible process may be admissible, but for articles of a finer or less simple form, the breakage of the machinery and the cost of attendance left little margin for profit. For many kinds of engine-work it is now cheaper to leave the forging rough, and take off the superfluous metal with a slotting or planing machine, than to allow a smith to spend his time in attempting to work exactly to drawing. In our textile machinery, however, there is an immense quantity of work to be done, of a slight character and of uniform dimensions. Mr. W. Ryder, of Bolton, has patented a forging machine more particularly adapted for this class of work, a specimen of which appeared in the Great Exhibition. No fire being allowed in the building, the effect of the machine is shown upon lead, which displays its power to great advantage. Fig. 1 is a front view, and fig. 2 an end view of the machine; fig. 3 is a section across the swages, and the apparatus connected with their motion. The machine consists of a strong cast-iron frame, carrying the driving-shaft *a*. On this shaft are forged eccentrics, which

give motion to the upper swage-holders, *b b*. These swage-holders are guided vertically by the frame, whilst the motion required by the eccentric is allowed for by the pieces, *c c* the toes of which work in the hollow on the top of the swage-holder. Each upper swage-holder is provided with a spiral spring, shown in fig. 3, which bears on a key fixed in the frame, and raises the swage after the eccentric has depressed it. A slot is cut in the swage-holder to allow it to slide on the key.

Machines of this class are always liable to breakage from a bar of too large a size being put between the swages. This can only be remedied by allowing some elasticity, which in this case is ingeniously effected in the following manner. A space, *e*, in the lower swage-holder is filled with cork, which can be compressed by the screw *f* to any degree of hardness. The screw *g*, which passes through the nut *h*, let into the framing, serves to raise the lower swage bodily, when it is required to vary the size of the work to be executed. The tool *i* forms a pair of shears to finish the work to a proper length, by moving the handle *k*, which, acting on an eccentric, raises the lower tool to meet the upper one. This arrangement is necessary, as, from the rapid motion of the tools, which make 600 or 700 blows per minute, it would be impossible to introduce the work without bruising it. *o o o o* are a series of rests, one being opposite to each pair of tools, which can be adjusted both in height and horizontal distance by means of the screws *n r*; the table *s s*, carrying the rests, can also be moved along the frame to facilitate the adjustment. In using the machine, the swages are adjusted so that by placing the rod of iron successively between them, it is drawn down to the size required, whilst the length of each part is accurately determined by placing the end of the rod in the rest. The machine cannot thus turn out the work too small, whilst, at the same time, it is so near the finished size, that very little has to be taken off in the lathe. As an example of its economy over hand-labor, we may state, that a man with the machine will make 17 dozen spindles per day, 15 inches long, and tapering from $\frac{3}{8}$ to $\frac{1}{8}$ inch, at a rate, piece work, of 5*d.* per dozen, whilst by

hand he could only turn out 6 dozen, for which he would be paid 10*d.* per dozen. In some kinds of work the economy is

still greater. All kinds of files, it is stated, may be forged at one-third the cost of hand-labor.



There are, no doubt, many other branches of business to which this machine is applicable, and we recommend it

with great pleasure as an interesting "fact" to all our mechanical friends who desire to keep pace with the times.

Fig. 2.

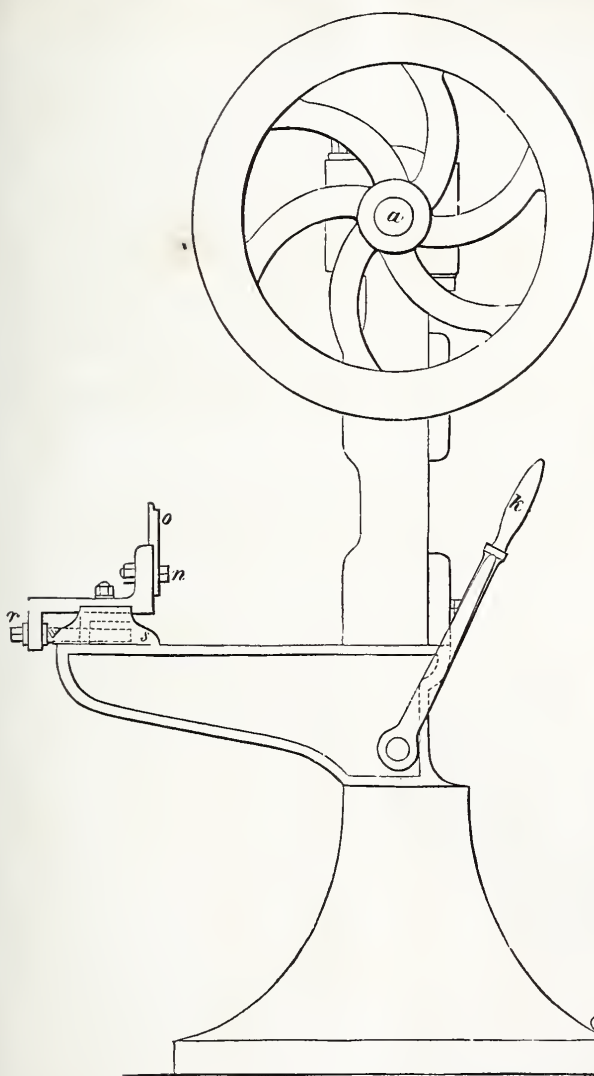
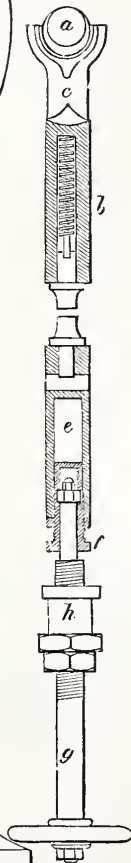


Fig. 3.



STONE AND IRON CONGLOMERATE FOR LIGHT-HOUSES, ETC.

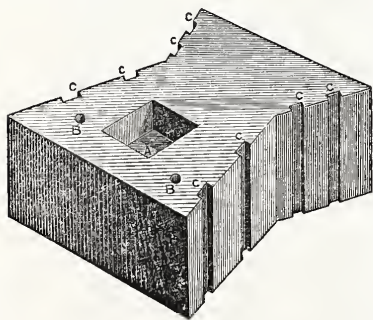
For Appletons' Mechanics' Magazine.

MUCH has been said and written upon the subject of the various methods of constructing light-houses, and an opinion

seems to have been nearly unanimously expressed of confidence in the plan first introduced by Smeaton in the Eddystone

and followed by the Stephensons in Bell-Rock and Skerryvore light-houses. The expense, however, of the stone column has been frequently urged against its adoption in other localities, and passing by the question of whether any plan is too expensive which secures so satisfactory and reliable a structure, I offer the following as a method of avoiding a very considerable part of the cost, while securing greater strength and greater stability than can be afforded by granite, or sandstone and granite, as used in the above-mentioned structures.

I will promise by remarking, that the great expense which was incurred in the erection of these columns was owing to the peculiar form given to the blocks, and to the methods employed to make them mutually sustaining, to prevent lateral motion or lifting; in fact, to give the whole structure the character of a solid mass. Without going into the details of the various devices for connecting them, it may be stated, that each block was of a double dovetailed form, so as to interlock with those within and outside it in the same course; that a series of marble joggles, one foot cube, were let into holes A in the upper and lower



faces of the blocks which came in contact, so as to prevent lateral shifting; that holes BB were drilled or "jumped" through the blocks and into those beneath them for the insertion of oaken treenails, which held them down; and that grooves c c c c were cut in the receding sides, or, as Smeaton called it, "the waist of the block," by the insertion of wedges, in which they were temporarily clamped to the blocks immediately adja-

cent, in the same circular course. This is a long and expensive process with ordinary stone, and it becomes an almost endless task with such intractable material as granite.

After the lapse of so many years, it seems needless to enlarge upon the ultimate economy of such structures as the Eddystone, it having been built in 1759, and not having required any repairs since that time; but any invention or contrivance which would materially reduce the first cost of such structures would certainly be of great importance.

By filling broken granite (previously gradually heated) into a mould of any desired form, and pouring in molten iron,—which fills every interstice between and around the stones,—a conglomerate block is formed at an expense (varying in places with the cost of the materials) of about two dollars per cubic foot, and of any required shape for interlocking, while by means of cores it is furnished with all the treenail holes, the recesses for the joggles, the grooves for the wedges, the dovetailed hole for the lewis for manipulating it, and for any species of bond or attachment that can be devised. The granite not being disintegrated by the contact of the metal, which latter has a continuous honeycomb structure, the conglomerate has great power of resisting compression, and also great tensile strength, the two qualities which give it value in this connection: its strength being as a cellular block of iron with its cavities so filled with granite as to preserve its chambers from being crushed in.

The cost of the conglomerate, as has been said, will vary in different places: the refuse of the granite quarry is what is required, and iron of sufficiently good quality for this purpose may be had at low rates. The proportions of the materials may likewise be varied according to the purpose to which it is to be applied; they may be as follows:

Granite	150 lbs.,	occupying	$\frac{3}{4}$	of a cub. ft.
Iron	150 "	"	$\frac{1}{4}$	" "
300 "				1 cubic ft.

Estimating the iron at \$20 per ton, and the granite at \$6.66 per ton, the cost of the conglomerate would be \$2 per cubic foot.

There are 13,147 cubic feet of stone

in the Eddystone, and 28,530 cubic feet in the Bell Rock, and the cost per cubic foot in the former was probably about \$6 per cubic foot, and of the latter about \$7.50 per cubic foot.

Mention has been made of the methods adopted by Smeaton for securing the stones in what he called the "fundamental solid" portion of the building, namely, dovetailing the blocks to those within and beyond them in the same plane, treenailing and joggling them to those above and beneath them, and introducing wedges for temporary security between them and the adjacent blocks in the same circle. Ascending in the structure, the difficulties became somewhat greater, and the bond was varied accordingly. By a detail of the devices, it will be seen that additional facilities for cramping and interlocking became more and more necessary.

When the fourteenth course was reached, provision was made by a doorway for entering the light-house, and a well for a staircase was carried up the centre of the building to the twenty-fourth course inclusive, which completed the "solid" portion of the structure. It was necessary that the stones immediately surrounding the well should be scarfed together so as to form a nucleus for the concentric circles of stones which surrounded them. This involved a complicated form and considerable expense, the chisel being relied upon for producing it. The joggles were reduced in size in the "solid" portion, and doubled in number.

With the twenty-fifth course the superstructure commenced, which was carried up, one course thick, to the balcony floor—the foundation for the lantern—that is, to the forty-sixth course, 70 feet above the base of the structure. Here it became necessary to change the system of securing; and from the twenty-fifth the courses were entirely of the moorstone or Cornish granite, a material which is not subject to disintegration from exposure to the weather. Smeaton here remarks:

"These (walls) being made with single blocks in the thickness, so that 16 pieces might compose the circle, would from its figure compose a stout wall; yet moorstone, as has been observed, being a tender kind of stone in respect of the union of its component parts, any

method of dovetailing the blocks together at this thickness appeared to me impracticable to any good purpose."

He therefore adopted a system of iron cramps, set in with lead, to attach each block to those adjacent in the same circle, and inserted joggles of marble in the centre of the upper face of each block, so that they would cross joints of the blocks above, into which one-half of each joggle projected; that is, the joints of the upper blocks were broken by those below, and the joggles prevented them from shifting laterally on each other. Level with the upper faces of the 29th, 34th, 40th, and 46th courses are floors dividing the building into rooms for living and storage, and which are supported by arched ceilings, to sustain the outward thrust of which it became necessary to provide additional security. Although with a perfectly lateral strain, the blocks maintaining a horizontal position, a force, to shift them laterally, must be equal to one which would cut the joggles in half, yet they afforded comparatively small protection against tilting; and from the small cohesive strength of the granite, Smeaton was not satisfied to depend upon the cramping-irons. He therefore channelled in the middle of the upper faces of each of these courses, and also the course immediately below each of these, and upon which a part of the thrust was imposed, a circular groove about 4 inches wide and deep, in which a chain, the links made of $1\frac{1}{4}$ inch square iron, was placed, lead being run in to fill up the channel even with the face of the course, with the exception of cavities left for the joggles securing the course immediately above. It is evidently inferred from Smeaton's language, that he would have treenailed the blocks in the superstructure had they been of a material less intractable; as it was, they were only held down by their weight and the cement.

How much of this ingenious contrivance of joggles and imbedded chains might have been spared, had the material been such that the contiguous blocks might have been securely locked together, so as in effect to form one annular block, and which would have allowed each floor to have been made of one piece, or of sections securely locked together, by which their weight would have been vertically imposed upon the course

of stone below, themselves, by extending to the exterior of the structure, forming one entire course, with the same facilities for securing them to those above and below, and forming a series of heads, as it were (like the floors in Rudyard's), adding to the strength by bracing instead of diminishing it by thrust.

It is worthy of remark, how much pains Smeaton was at to render the vertical joints of the masonry water-tight, by making vertical grooves in the middle of the faces which came in contact, and driving joint stones into the rhomboidal cavity, which was first partially filled with semi-fluid cement. This operation, he says, required great care, owing to there being *no provision for holding down the stones to those beneath them*, and in pressing the joint stone too forcibly into the cavity, the cement was liable to be forced into the interstice between the layer of stones, breaking the horizontal joint. Such ingenious appliances would be unnecessary with a block susceptible of being locked to those above, below, and around, and whose cohesive strength is such that they may be packed steam-tight, if desired.

The Eddystone Light-house is solid for 35 feet from the base, the design being to oppose as high as the unbroken waves a solid mass, whose inertia would prevent it from being shifted by their force. This conglomerate, being one-half heavier than granite, would fulfil this requirement, even more effectually than the granite and Portland stone, of which the Eddystone is composed.

The above data show a sufficient margin to cover all doubts as to the economical value of this material, in cases where peculiar forms are necessary for the blocks, and provision is required for securing them together. From them it appears,—

1. That the cost of masonry-work of this material is considerably less than one-half the cost of the Eddystone masonry-work.
2. That it has greater strength.
3. That it has one-half greater weight.
4. That it affords greater facility for interlocking and cramping, qualities especially valuable where the structure is but one course thick.
5. That while it answers practically (in this connection) all the purposes of

cast-iron, its cost is but one-third that of the latter.

Stephenson, in a late paper read before the Royal Scottish Society of Arts, says, after an enumeration of disasters attending the erection of some marine works:

"From the foregoing statement of facts, which show us the almost total dependence of one stone upon another, and the havoc which may ensue from even a single stone near the bottom of the structure being left insecure, we may readily see the advantage which is to be derived from connecting them together; * * * and hence in many light-houses and harbor works great expense is incurred in joggling the stones, or in connecting them together with oaken treenails. The great advantage, therefore, of any contrivance which could be easily and above all quickly applied for the purpose, without the expense of jumping holes or cutting the stones, appears very evident."

The above reads like a running commentary upon the adaptation of the conglomerate to the erection of marine works.

GEORGE H. KNIGHT, *Patentee*.

Cincinnati.

THE CENTRIFUGAL PUMP.*

ONE of the *lions* in this department of the Great Exhibition is Appold's Centrifugal Pump, which seems, indeed, to rank next, in attraction as well as in noise, to Applegath's wonderful printing-machine, by which *The Times* and *The Illustrated News* are printed. By means of a little wheel, 12 inches in diameter, with twisted apertures, radiating from an open central space, there is made to rise to the roof of the apartment a mass of water which produces a broad and heavy, noisy, and continuous waterfall that might turn a powerful water-wheel. Of course, however, to produce this striking result, sufficient power is requisite to produce that rapid revolution in the little wheel which does the work. The wheel itself contains only a single gallon of water when its apertures are full, yet, by being made to revolve at the rate of 607 revolutions in a minute, it lifts no less than 1800 gallons in course of that time; so that it must be filled and emptied about three times in the course of every revolution. In fact, the disk, once under water, where it works, may be said to carry

* Civil Engineer and Architect.

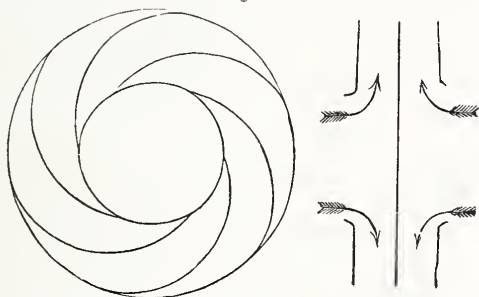
the water through its apertures in continual streams, or threads, or cables rather, of water, forced out at several interspaces by the centrifugal power of its rapid rotation; so that the weaving of such threads of water is not so fruitless a process as the ancient one of twisting ropes of sand. By-the-way, could not quicksands themselves be very rapidly scooped out by a machine somewhat like this?

The direct purpose of Mr. Appold's invention, which he has most liberally made a present of to the public, so far as regards any private patent right which he might have reserved to himself, is for the drainage of marshes: but to this might be also added such other uses as that of clearing cofferdams for docks, &c. Indeed, it is stated by the inventor to be "particularly well adapted for a tide-pump, discharging more water the lower

the lift, the pump going the same speed; while other pumps discharge only their contents, no matter how low the lift." The machine at work was manufactured by Messrs. Easton and Amos, of Southwark. We examined the interior of the perpendicular *leader*, if we may so call it, through which the water is lifted from a narrow slope below, in order to assure ourselves that the disk or wheel was of something like the dimensions stated. A small one was also exhibited, which, though only three inches in diameter, evolved 150 gallons a minute, and sent a strong jet up to the roof. A modification of Mr. Appold's invention, though called "Bessemer's Centrifugal Disk-Pump for Draining Land," is also exhibited. The disk is 6 feet in diameter, and it discharges 20 tons a minute.

Mr. Appold's pump consists of a hollow disk, or cylinder, as shown in the

Fig. 1.



annexed engraving (fig. 1), 12 inches diameter and 3 inches wide on the rim, with a circular opening in the centre of 6 inches diameter. This cylinder is inclosed on both sides, excepting the central opening, and is entirely open all round the rim. The disk is placed vertically on a shaft passing through its centre, and on the end of this shaft is fixed a pulley 12 inches diameter, for driving it by a strap from the gearing of an oscillating steam-engine, having a cylinder $8\frac{1}{2}$ inches diameter and 2 feet 2 inches stroke; and at the time we saw it at work, the steam-gage in the machine-room near the pump showed a pressure of steam of 28 lbs. on the square inch, and the engine was making 58 revolutions per minute, which will give the velocity of the piston at 250 feet per minute.

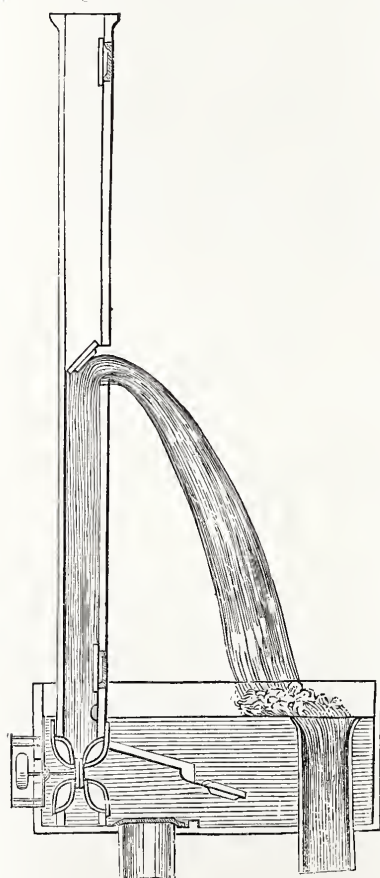
In order to raise the water, the disk is

placed near the bottom of a vertical trunk, as shown in the engravings. Fig. 2 is a vertical section. The trunk is 7 feet 6 inches long, 1 foot wide, and about 22 feet high, and at the bottom of this trunk is a tank to receive the water as it flows out of the upper valves. On the face of the trunk are three outlet valves, one placed about a foot above the surface of the water in the tank; a second one at ten feet, and a third one at 17 feet above. The lower part is a tank with a vertical pipe to carry off the water into a lower tank; and when the vertical valve is closed, the other valve at the bottom is opened, and the water can then be drawn up from the lower tank, giving an additional lift of 7 or 8 feet.

The remarks we are now about to make will refer to a lift of 10 feet. At the time of making our observations, the

water was issuing out of the valve at this lift at the rate of 1600 to 1800 gallons per minute, and the disk was making 800 revolutions in that time. At this speed the velocity of the rim would be equal to 2512 feet per minute, which, if multiplied by 3 inches (the width of the disk), would give a superficial area of 628 feet for the delivering orifice. The capacity of the

Fig. 2.



disk is equal to 339 cubic inches, or 1.224 gallon—say $1\frac{1}{4}$ gallon. If this be multiplied by 800, the number of revolutions, it would only give 1000 gallons per minute, whereas the delivery is, according to Mr. Appold's statement, equal to 1800 gallons. This may be easily ac-

counted for when we consider the large superficial area of the outlet per minute.

If we take Mr. Appold's statement as the work done, at 1800 gallons per minute, it will be equal to $1800 \times 10 \text{ lbs.} \times 10 \text{ ft.} = 180,000 \text{ lbs.}$ lifted 1 foot high per minute; and which, if divided by 33,000 pounds (1 horse-power), will give as the result about $5\frac{1}{2}$ horse-power.

The power of the engine at the time it was doing this work was equal to $8.5^2 \times .7854 \times 28 \text{ lbs.} \times 250 \text{ ft.}$, the velocity of the piston = 397,000 lbs., lifted 1 foot high per minute, which, if divided by 33,000 lbs., will give 12 horse-power.

By this statement of figures, it appears that the effective duty performed by the engine is not equal to half its power. This is by no means a very satisfactory result, and shows that the centrifugal pump cannot be compared with a good pumping-engine.

Mean results of various Experiments with a 12-inch Pump, 6-inch Drum, and Lift 5 feet 6 inches high, and the Strain calculated by a Dynamometer on the Steam-Engine.

Number of revolutions per minute.	Pounds raised 1 foot high per minute.	Strain on the Steam-Engine in lbs., raised 1 foot high per minute.	Per centage of work done, compared with power expended.
359	55	18052	.3
375	5500	25928	21.2
380	11000	29857	36.8
387	16500	35272	46.7
394	22000	39625	55.5
400	27500	46495	59.1
412	33000	51773	63.7
427	38500	58353	65.9
440	44000	64968	67.7
453	49500	71157	69.5
474	55000	78923	69.6
481	60500	85377	70.8
495	66000	91750	71.9
518	71500	98454	72.6
535	77000	105887	72.7
563	82500	118504	69.6
580	88000	125726	69.9
595	93500	132716	70.4
607	99000	143021	69.2

The following observations are extracted from Mr. Appold's prospectus:

"From the results of various experiments, it has been found that the loss of power would not be more than 30 per

cent. It will be observed, the centrifugal force is not so much in the large diameter, on account of the water moving more in a straight line, but that is compensated for by the force being applied to a greater depth of water, being 5 feet in the 20 feet, and only 3 inches in the 1 foot; 159 revolutions with the 1 foot will raise the water 1 foot high without discharging any; 318 revolutions, 4 feet; 636 revolutions, 16 feet; and 1272 revolutions, 64 feet high. The highest elevation to which the water has been raised with the 1-foot pump is 67 feet 8 inches, with 1322 revolutions per minute, being less than the calculated height, which may be accounted for by leakage with the extra strain.

"While the 1-foot pump is raising 8 tons of water 5 feet 6 inches high per minute, there is no greater strain on any part of the pump than 160 lbs. on the 6-inch drum, which is equal to a leverage of 3 inches. It will pass almost any thing that is small enough to go through, there being no valves. A quantity of walnuts (about half a gallon) were thrown into the 1-foot pump all at once, when it was at full speed, and they passed through without breaking one."—*Architect and Engineer's Journal*.

MECHANICS FOR THE MILLION, NO. VI. WORK OF STEAM.

Work of Steam, having a mean pressure.

20. If steam in the cylinder *A D* exert any constant, or mean pressure, upon the piston *A B*, say of 30 lbs. per square inch, then if a weight of 30 lbs. be placed upon every inch of surface in the piston, the elastic vapor would just be able to move the piston with its weights through the length of the stroke in opposition to gravity; therefore the work performed upon 1 inch of the piston in one stroke will be the pressure of the steam upon 1 inch multiplied by the number of feet in the stroke, and the work upon the whole piston will be the work upon 1 inch multiplied by the number of inches in the whole piston.

In the high-pressure engine, the pressure of the atmosphere,—about 15 lbs. per square inch,—is opposed to the pres-

sure of the steam. Besides this, a considerable portion of the pressure of the steam is required to overcome the friction of the parts of the engine. As a mean estimate, 1 lb. to the square inch is allowed for the friction due to the engine when unloaded; and an additional friction of $\frac{1}{4}$ the effective pressure, or useful load, for the resistance necessary to overcome the friction of the loaded engine. Thus, if the pressure of the steam is 50 lbs., we shall have 15 lbs. for the pressure of the air, and 1 lb. for the resistance of the friction of the unloaded piston, and then the remaining 34 lbs. will be taken up by the useful load and the friction arising from that load, that is, load + $\frac{1}{4}$ load = 34 lbs., or $\frac{8}{5}$ load = 34 lbs., and therefore load = 29.75 lbs. This load is called the effective pressure of the steam.

In the condensing engine, the pressure of the vapor in the condenser (estimated at a maximum about 4 lbs. per square inch of the piston) must be used in the place of the atmospheric pressure; thus, in this case we have load + $\frac{1}{4}$ load + 1 + 4 = total pressure of the steam.

Ex. 1. The area of the piston of a steam-engine is 2000 square inches, the mean effective pressure of the steam 15 lbs., the length of the stroke 8 feet, the number of strokes performed per minute 20; required the H. P.

Work done upon 1 inch of the piston in 1 stroke = $15 \times 8 = 120$.

Work upon the whole piston in 1 stroke = 120×2000 .

Work upon the whole piston in 20 strokes = $120 \times 2000 \times 20$.

As this is also the work done per minute, we have,

$$\text{H. P.} = \frac{120 \times 2000 \times 20}{33000} = 145.4.$$

Ex. 2. The area of the piston of a high-pressure engine is 500 inches, the length of the stroke 6 feet, the pressure of the steam 40 lbs., and the number of strokes made per minute 16; it is required to find the number of feet of water which the engine will pump per minute from a mine whose depth is 80 fathoms, making the usual allowance for friction and the modulus of the pump.

Here, load + $\frac{1}{4}$ load + 1 + 15 = 40; $\therefore \frac{8}{5}$ load = 24; and load = 21 lbs.

$\therefore$ Useful work of engine per minute = $21 \times 500 \times 6 \times 16 \times .66 = 665280$.

Work in pumping 1 foot of water = $62.5 \times 80 \times 6 = 30000$.

$$\therefore \text{No. c. ft.} = \frac{665280}{30000} = 22.1.$$

Ex. 3. Required the same as in the last example, when the pressure of the steam is 48 lbs., and the depth of the mine is 160 fathoms. *Ans.* 14.7.

Ex. 4. Required the H. P., as in *Ex. 1*, when the area of the piston = 500 inches, pressure of the steam = 33 lbs., length of the stroke = 4 feet, and the number of strokes per minute = 16. *Ans.* 32.

Ex. 5. What must be the mean effective pressure of the steam in the last example, so that the engine may do the work of 20 horses?

$$\text{Work engine per min.} = 20 \times 33000.$$

$$\text{Work of 1 lb. pressure of steam per min.} = 500 \times 4 \times 16.$$

$$\therefore \text{No. lbs.} = \frac{20 \times 33000}{500 \times 4 \times 16} = 20\frac{1}{2}.$$

Or thus:

Let x = no. lbs. pressure on each sq. in. of the piston; then, work steam per min. = $x \times 500 \times 4 \times 16$.

$$\therefore x \times 500 \times 4 \times 16 = 20 \times 33000;$$

$$\therefore x = 20\frac{1}{2}.$$

Ex. 6. The area of the piston of a high-pressure engine is 3000 inches, the length of the stroke 10 feet, the number of strokes per min. 16; required the mean pressure of the steam, so that the engine may perform the work of 120 horses, making the usual allowance for friction.

$$\text{Work per min. of steam with 1 lb. effective pressure} = 3000 \times 1 \times 10 \times 16.$$

$$\text{Effective work per min.} = 33000 \times 120.$$

$$\therefore \text{Effective pressure on 1 inch of the piston} = \frac{33000 \times 120}{3000 \times 10 \times 16} = 8.25 \text{ lbs.}$$

$$\therefore \text{Pressure steam} = 1 + 15 + 8.25 + \frac{1}{7} \times 8.25 = 25.4 \text{ lbs.}$$

Ex. 7. Required the same as in the last example, when the area of the piston = 800 inches, the length of the stroke = 6 ft., the number of strokes per min. = 20, and the H. P. = 40. *Ans.* 31.7 lbs.

Ex. 8. The length of the stroke of a high-pressure engine is 8 feet, the area of the piston 1000 inches, and the number of strokes made per min. 20: what must be the pressure of the steam so that the engine may pump 80 cubic feet of water per min. from a mine whose depth is 120 fathoms, making the usual

allowance for friction and the modulus of the pump?

$$\text{Work done per min.} = 80 \times 62.5 \times 120 \times 6 = 3600000.$$

$$\therefore \text{Work engine per min.} \times .66 = 3600000.$$

$$\text{And work engine per min.} = 5454545.$$

Useful work on 1 inch of the piston in

$$1 \text{ stroke} = \frac{5454545}{20 \times 1000} = 272.$$

$$\therefore \text{Useful load} = \frac{272}{8} = 34 \text{ lbs.}$$

$$\text{Pressure steam} = 34 + \frac{34}{7} + 15 + 1 = 54.8 \text{ lbs.}$$

Ex. 9. Required the same as in the last example, when the depth of the mine is 100 fathoms, and the length of the stroke 10 feet. *Ans.* 41.9 lbs.

Work of Steam, with a mean pressure, considered in relation to the water evaporated.

21. The true source of work in the steam-engine is the evaporating power of the boiler. The magnitude of the work not only depends upon the quantity of water evaporated in a given time, but also upon the temperature, and consequently the pressure at which the steam is formed. Experimental tables have been formed, giving the relation of the volume and pressure of steam raised from a cubic foot of water;* these tables will enable us to find the volume of the steam when its pressure and the volume of the water are given, and *vice versa*. The following will serve as a specimen of this table.

Volume of a cubic foot of water in the form of steam at the corresponding pressures.

Press. lbs.	Vol.	Press. lbs.	Vol.
30	883	48	575
35	767	50	554
40	679	55	508
45	610	60	470

Ex. 1. In a high-pressure engine the area of the piston is 100 in., the length of the stroke 2 ft. 6 in., the effective evaporation of the boiler 335 c. ft. per minute, the pressure of steam in the cylinder 50 lbs., and the loss due to friction as ex-

* Hann has given a general formula, expressing this relation with remarkable exactness, between the range of 5 and 200 lbs. pressure. This formula is $V = a + b P^2$; where V is the volume of a cubic foot of water in the form of steam at P lbs. pressure; $a = 12.5$, $b = 20570$, and $a = -.9301$. See Mr. Hann's able work on the steam-engine.

plained in Art. 20; required the useful load per square inch of the piston, and the useful H. P.

Here by Art. 20, $\frac{2}{3}$ useful load = $50 - 15 = 34$ lbs.

$\therefore$ Useful load = 29.75 lbs.

Now by the experimental table, a cubic foot of water in the state of steam at 50 lbs. pressure has a volume of 55.4 cub. ft.

$\therefore$ Volume of steam evaporated per minute = 55.4×335 .

Volume discharged at each stroke = $\frac{100 \times 2.5}{144} = 1.73$.

$\therefore$ Number of strokes per minute = $\frac{55.4 \times 335}{1.73} = 107$.

Work in 1 stroke = $29.75 \times 100 \times 2.5$.

Work in 1 minute = $29.75 \times 100 \times 2.5 \times 107$.

And H. P. = $\frac{29.75 \times 100 \times 2.5 \times 107}{33000} = 24$.

Ex. 2. Required the H. P., as in the last example, when the area of the piston = 120 inches, the length of the stroke = 2 ft. 3 in., the evaporation = 4 ft., and the pressure of the steam = 48 lbs.

Ans. 28.

Ex. 3. The area of the piston of a high-pressure engine is 144 inches, the length of the stroke 3 feet, the pressure of the steam in the cylinder 48 lbs., the number of strokes per minute 20, and the loss of friction as usual; it is required to find the useful load, the water evaporated per hour, and the useful H. P. of the engine.

Useful load + $\frac{1}{3}$ useful load = $48 - 15 = 32$ lbs.

$\therefore$ Useful load = 28 lbs.

Volume steam discharged per min. = $\frac{144 \times 3}{144} \times 20 = 60$ cubic feet.

$\therefore$ Volume steam discharged per hour = 3600.

By the experimental table 1 c. ft. of water yields 575 c. ft. of steam at 48 lbs. pressure.

$\therefore$ Cubic feet water evaporated per hour = $\frac{3600}{575} = 6.2$.

H. P. = $\frac{144 \times 28 \times 3 \times 20}{33000} = 7.3$.

Ex. 4. Required the same as in the last example, when the area of the piston
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= 96 inches, length of the stroke = $2\frac{1}{2}$ ft., pressure of the steam = 60 lbs., and the number of strokes = 100.

Ans. 21.2 ft., and H. P. = 28.

Ex. 5. Required the duty of the engine in Ex. 3, allowing that 1 bushel of coals can evaporate 11.5 feet of water.

Here the useful work per hour = $144 \times 28 \times 3 \times 20 \times 60$.

Now this work is done by 6.2 feet of water.

$\therefore$ Work of 11.5 ft. of water, or 1 bus.

of coals = $144 \times 28 \times 3 \times 20 \times 60 \times \frac{11.5}{6.2} =$

27 millions nearly, which is called the duty of the engine.

Observation.—It has been found, by experiment, that whatever may be the pressure at which the steam is formed, the quantity of fuel necessary to evaporate a given volume of water is always the same. Hence it follows, that it is most advantageous to employ steam of a high pressure.

Ex. 6. A train of 100 tons moves at the uniform speed of 20 miles per hour upon a level rail; the resistance of friction upon the rail is 7 lbs. per ton, the resistance of the atmosphere 33 lbs. upon the whole train when the speed is 10 miles per hour, the diameter of the driving-wheel 5 feet, the area of the piston 110 inches, the length of the stroke $\frac{4}{3}$ ft., and in addition to the resistances of the preceding questions, the resistance due to the blast-pipe is 1.75 lbs. per inch of the piston when the speed of the train is 10 miles per hour. It is required to determine the pressure of the steam, the evaporation of the boiler, and the number of bushels of coals necessary for a journey of 200 miles, allowing that 1 bushel will evaporate 11.5 cubic feet of water.

Total resistance to the motion of the carriages = $7 \times 100 + (\frac{20}{10})^2 \times 33 = 832$ lbs.

Space moved over in 1 revolution of the driving-wheel = 5×3.1416 .

$\therefore$ Work in 1 revolution = $5 \times 3.1416 \times 832$.

Work of 1 lb. per inch pressure on the pistons in 1 revolution of the driving-wheel = $1 \times 110 \times \frac{4}{3} \times 4$. It will here be observed, that the engine has two cylinders, and that each piston makes two strokes while the driving-wheel turns round once.

∴ Effective pressure on 1 inch of the piston = $\frac{5 \times 3 \cdot 1416 \times 832}{110 \times \frac{4}{3} \times 4} = 22 \cdot 27$.

It has been found by experiment, that the resistance of the blast-pipe increases with the speed of the engine.

∴ Resistance due to the blast-pipe = $1 \cdot 75 \times \frac{20}{10} = 3 \cdot 5$ lbs.

∴ Total pressure steam on the piston = $22 \cdot 27 + \frac{1}{7} \times 22 \cdot 27 + 3 \cdot 5 + 1 + 15 = 45$ lbs., nearly.

Number revo. driving-wheel per min. $\frac{20 \times 5280}{60 \times 5 \times 3 \cdot 1416} = 112$.

∴ Number of strokes of the piston per min. = $112 \times 4 = 448$.

∴ Volume steam discharged per min. = $\frac{110}{144} \times \frac{4}{3} \times 448 = 456$ feet.

But from the experimental tables 1 foot of water produces 610 feet of steam at 45 lbs. pressure.

∴ Number of feet of water evaporated per min. = $\frac{456}{610} = 74$.

As 1 bushel of coals evaporates 11·5 feet of water, the number of bushels of coals used per min. = $\frac{74}{11 \cdot 5}$.

∴ Number of bushels for 10 hours, or the distance of 200 miles = $\frac{74}{11 \cdot 5} \times 60 \times 10 = 38 \cdot 6$.

Ex. 7. Required the same as in the last example, when the speed = 40 miles, diameter of the driving-wheel = 6 feet, area of piston = 120 inches, and the length of the stroke = 1·5 feet.

Ans. Pressure = 60 lbs., nearly; 1·98 ft. of water per min.; 51 bush.

Ex. 8. Supposing the weight of the goods and passengers moved in the last example to be 40 tons, what would be the cost of the transport of one ton per mile, due to the expenditure of fuel, allowing the coals to be 15*d.* per bushel?

Ans. About $\frac{1}{3}$ of a farthing.

Ex. 9. In a locomotive engine the area of the piston is 90 inches, the length of the stroke 16 inches, the pressure of the steam 50 lbs., the effective evaporation of the boiler 7 cubic feet per minute, the diameter of the driving-wheel 5 feet; required the speed of the train per hour.

At 50 lbs. pressure 1 foot of water forms 554 feet of steam.

∴ Volume steam formed per min. = $554 \times 7 = 387 \cdot 8$ feet.

Volume of steam discharged in 1 revolution of the driving-wheel = $\frac{90 \times 16}{1728} \times 4 = 3 \cdot 33$ cubic feet.

∴ Number revolutions of wheel per min. = $\frac{387 \cdot 8}{3 \cdot 33} = 116 \cdot 3$.

∴ Space moved over by the carriage per min. = $5 \times 3 \cdot 1416 \times 116 \cdot 3$ feet.

And space moved over per hour = $\frac{5 \times 3 \cdot 1416 \times 116 \cdot 3 \times 60}{5280} = 20 \cdot 7$ miles.

Ex. 10. Required the speed, in the last example, when the pressure of the steam is 60 lbs., and the diameter of the driving-wheel 6 feet. *Ans.* 21·1 miles.

Ex. 11. The area of the piston of a locomotive is 80 inches, the length of the stroke is 15 inches, the pressure of the steam 48 lbs., and the diameter of the driving-wheel 5 feet; required the effective evaporation of the boiler, so that the train may have a speed of 30 miles per hour; required also the effective H. P. of the engine, and the weight of the train, taking the resistances to the motion of the piston the same as in *Ex. 6*.

Number of revolutions of the wheel per min. = $\frac{30 \times 5280}{60 \times 5 \times 3 \cdot 1416} = 168$.

∴ Number of strokes of the piston per min. = $168 \times 4 = 672$.

Load $+ \frac{1}{7}$ load = $48 - 15 - 1 - 1 \cdot 75 \times 3 = 26 \cdot 75$.

∴ Load = $\frac{26 \cdot 75 \times 7}{8} = 23 \cdot 4$ lbs.

∴ Effective work per min. = $23 \cdot 4 \times 80 \times \frac{1}{4} \times 672 = 1572480$.

And effective H. P. = $\frac{1572480}{33000} = 47$.

Now this effective work of the engine has to support a speed of 30 miles per hour, or 2640 feet per minute, in the train in opposition to the resistances of friction and the atmosphere.

Work due to the resistance of the atmosphere per min. = $(\frac{3 \cdot 9}{10})^2 \times 33 \times 2640 = 784080$.

∴ Work due to friction per min. = $1572480 - 784080 = 788400$.

Work of friction when the train is 1 ton = 7×2640 .

∴ No. tons in the train = $\frac{788400}{7 \times 2640} =$

42·6.

$$\begin{aligned} \text{Volume steam discharged each stroke,} \\ &= \frac{80 \times 1.25}{144}. \end{aligned}$$

$$\therefore \text{Volume steam discharged per min.} \\ &= \frac{80 \times 1.25 \times 672}{144}.$$

But, by the table, a cubic foot of water yields 575 feet of steam.

$$\therefore \text{No. ft. of water evaporated per min.} \\ &= \frac{80 \times 1.25 \times 672}{144 \times 575} = 81.$$

Ex. 12. Required the same as in the last example, when the area of the piston is 120 inches, the pressure of the steam 60 lbs., and the speed 50 miles.

Ans. Evaporation = 2.48 ft. H. P. = 157, and weight of the train = 50.3 tons.

Ex. 13. If the engine in *Ex. 11* move the train of *Ex. 4*, Art. 11, what must be the effective evaporation of the boiler, and the duty of the engine?

$$\text{Speed per min.} = \frac{18.4 \times 5280}{60} = 1620 \text{ ft.}$$

nearly.

$$\begin{aligned} \text{Number of strokes of the piston} &= \\ &= \frac{1620}{5 \times 3.1416} \times 4 = 412. \end{aligned}$$

Effective work of engine per min. = 40×33000 .

Work of 1 lb. effective pressure per min. = $1 \times 80 \times \frac{1}{2} \times 412$.

$\therefore$ Effective pressure of steam =

$$\frac{40 \times 33000}{80 \times \frac{1}{2} \times 412} = 32.$$

$\therefore$ Pressure steam = $32 + \frac{1}{7} \times 32 + 15 + 1$

$$\frac{18.4}{10} \times 1.75 = 55.7 \text{ lbs.}$$

The volume of 1 c. ft. of water in the form of steam at 55.7 lbs. pressure is 504 c. ft.

Number of c. ft. steam discharged per

$$\text{min.} = \frac{80 \times 15}{1728} \times 412 = 287.$$

$\therefore$ Number c. ft. water evaporated per min. = $\frac{287}{504} = 57$.

Now this water performs 40×33000 units of work.

$\therefore$ Work 11.5 ft. water, or 1 bushel of coals = $40 \times 33000 \times \frac{1.1.5}{3.7} = 27$ millions, which is the duty of the engine.

Ex. 13. Required the duty of the engine in *Ex. 1*, and the cost of a horse-power in a day of 6 hours, arising from

the expenditure of fuel, allowing that a bushel of coals cost 4d.

Ans. $27\frac{1}{2}$ millions nearly, and costs $1\frac{1}{2}d$.

(To be continued.)

ENGINEERING PRIZE ESSAY:—ON THE MERCANTILE VALUE OF THE EXPANSIVE PRINCIPLE, AS APPLIED TO THE CONDENSING STEAM-ENGINE.

In March last the London Artisan (which, by-the-way, is a most valuable periodical, and one which is doing more to advance the true interests of mechanical science than any other within our knowledge) offered a prize for the best Essay on the mercantile value of the expansive principle applied to steam-engines; which prize has been awarded to H. C. Bosscha; and we insert the entire essay from the August number of the London Artisan for the benefit of our readers.

To make any steam-engine, moving any load, at any velocity, the cylinder is, in any unity of time, to be filled totally, or, working with expansion, partially—with steam, which must have a pressure equal to the resistance of the load, plus that, caused by the friction of the engine and the steam, remaining uncondensed. Hereto must be formed, in the same unity of time, a volume of steam, which, after having been reduced to the pressure, required in the cylinder to balance the resistance of the load (friction and uncondensed steam included), is justly capable of filling the cylinder the required number of times. Were the quantity produced a greater one, the piston would go accelerating; or, when the steam-passages were correspondingly narrowed, that is, when the steam was “throttled,” so that the steam was constrained to expand itself in the cylinder to the pressure of the load, the superfluous steam in the boiler would accumulate, and consequently increase in density, until the intensity of the fire was diminished, or it might escape by the safety-valves.

But when the volume of steam thus formed in the boiler at the pressure at which the safety-valve is loaded, is the maximum which the boiler is capable of producing, and the whole volume thus form-

ed is required to fill the cylinder—or a part of it, when working expansively—the number of times, corresponding with the required velocity of the piston, it is evident that the pressure in both the vessels, viz., the boiler and the cylinder, must be equal, or at least nearly so.* In this case, the engine may be said to be working at its maximum of useful effect for its particular degree of expansion at that time, which, the engine working without expansion at all, will be 0. For this particular case, that is, when the pressure in the cylinder during the whole stroke, or during part of the stroke before the steam is cut off, is equal to the pressure in the boiler, it is only possible to calculate the most advantageous degree of expansion. In this supposition, viz., that the volume and density of the steam produced in the boiler are maxima, the most advantageous degree of expansion may be calculated from the formula, for the absolute maximum of useful effect, as given in that most valuable work, *De Pambour Théorie des Machines à Vapeur* (ch. iv. art. 4),

$$\frac{l'}{l} = \frac{v'}{v},$$

where l' represents the part of the stroke that the steam is admitted, l the length of stroke, and consequently $\frac{l'}{l}$ the degree of expansion in parts of the stroke; v' denotes the specific volume of steam at the total pressure of the boiler, and v that of steam, supposed to be formed at a pressure equal to that of the uncondensed vapor, plus the friction reduced to the unity of the area of the piston.

As to the condition, the highest pressure in the cylinder may not surpass 50 lbs. on the square inch above the atmosphere, and as to our supposition, this will be also the pressure at which the safety-valves are loaded. Consequently, the maximum pressure in the boiler will be $50 + 14.7 = 64.7$ lbs. on the square inch above the atmosphere.

Allowing 4 lbs. on the square inch for the pressure of the uncondensed vapor, and $1\frac{1}{2}$ lbs. for friction, v must be the specific volume of steam, having a pressure of $4 + 1.5 = 5.5$ lbs. on the square inch.

* Though the pressure in both the vessels can never be quite equal, owing to the resistance of the steam-passages, the difference, however, is so very trifling, as to be neglected without great inaccuracy.

Now, after calculating the temperature t , from the formula,

$$t = 198.562 \sqrt{p - 98.806},$$

where p denotes the pressure in pounds, the specific volume of steam may be found by the formula—

$$\mu = 37.049 \frac{461.2 + t}{p},$$

where μ denotes the specific volume of steam at a pressure p .

Accordingly, v' and v are found to be 435.32 and 4218, so that—

$$\frac{l'}{l} = \frac{435.32}{4218} = 0.1032.$$

Thus, the most economical degree of expansion will be attained, when the steam is shut off, after the piston has performed 0.1032 parts of its stroke l .

Now, when the initial pressure π of the steam in the cylinder is known, being in this case 64.7 lbs. on the square inch, the mean pressure π' , during the whole stroke, may be found by the following formula, where the same letters denote the same values, and where e represents the hyperbolic logarithm of $\frac{l}{l'}$, or the common logarithm multiplied by 2.302585. This formula is

$$\pi' = \frac{l'}{l} (1 + e) \pi,$$

whereby is found $\pi' = 0.33756 \times 64.7 = 21.84$ lbs. on the square inch, or 3144.979 lbs. on the square foot. Allowing, as before, 5.5 lbs. on the square inch for uncondensed steam and friction, the mean useful pressure on the piston during the whole stroke will be $21.84 - 5.5 = 16.34$ lbs. on the square inch, or 2352.979 lbs. on the square foot.

Now knowing the mean useful pressure of the steam in the cylinder, we may calculate the area of piston and length of stroke, for the indicated horse-power 100, by the formula:

$$H. P. = 100 = \frac{a r v}{33000},$$

where a denotes the area of piston = $0.7854d^2$, d being the diameter, r the useful pressure on the piston, on the square foot, a being expressed also in square feet, and $v = 128^3 \sqrt{l}$, the velocity in feet.

As to the condition, l must be $=2d$, and remembering that $v=128^3\sqrt{l}$, the formula

$$100 \times 33 \cdot 000 = 0 \cdot 7854 d^2 \times 2352 \cdot 979 \times 128^3 \sqrt{2d}$$

$$= 0 \cdot 7854 + 2352 \cdot 979 + 1 \cdot 259921 d^{2\frac{1}{2}}.$$

So that
$$d^{2\frac{1}{2}} = \frac{33 \cdot 00000}{298014 \cdot 2} = 11 \cdot 073,$$

and diameter of cylinder, $d = \sqrt[2\frac{1}{2}]{11 \cdot 073} = 2 \cdot 8029$ feet, or $33\frac{3}{8}$ inches, nearly.

Length of stroke $l = 2 \times 2 \cdot 8029 = 5 \cdot 6058$ feet, or about 5 feet $7\frac{1}{4}$ inches.

Velocity per minute of piston $= 128^3 \sqrt{l} = 227 \cdot 37$ feet.

Now to find the feed-water required, we must first calculate how many times the cylinder must be filled per minute. The velocity of piston per minute is $227 \cdot 37$ feet, and so the number of single

$$\text{strokes } \frac{227 \cdot 37}{5 \cdot 6058} = 40 \cdot 56. \text{ Only } 0 \cdot 1032$$

parts of the cylinder ought to be filled at every stroke, but to that must be added $\frac{1}{20}$ of the whole content of the cylinder, for the waste space, so that the whole volume of steam required per minute will be $(0 \cdot 1032 + 0 \cdot 05) \times 6 \cdot 1697 \times 5 \cdot 6058 \times 40 \cdot 56 = 214 \cdot 91$ cubic feet. The volume of steam at a total pressure of $64 \cdot 7$ lbs. on the square inch, as compared to the water which has produced it, is $435 \cdot 32$,

$$\text{so that } \frac{214 \cdot 91}{435 \cdot 32} = 0 \cdot 48242 \text{ cubic feet, is the}$$

quantity of water required per minute. But as, on an average, $\frac{1}{20}$ of the total bulk of water furnished to the boiler passes to the cylinder without being evaporated, $\frac{1}{19}$ of the number found must be added to it, to obtain the total quantity of feed-water to be furnished to the boiler. Thus, $0 \cdot 48242 + \frac{1}{19} \times 0 \cdot 48242 = 0 \cdot 50785$ cubic feet of feed-water to be furnished to the boiler per minute, and $0 \cdot 50785 \times 60 = 30 \cdot 471$ cubic feet per hour.

As to the condition, 1 cubic foot of water is to be evaporated by 7 lbs. of coals, and as $30 \cdot 471$ cubic feet of water must be evaporated per hour, the corresponding quantity of coals to be burned in the same time will be $30 \cdot 471 \times 7 = 213 \cdot 297$ lbs., which, at a rate of one half-

$$\text{penny each 7 pounds, will cost } \frac{213 \cdot 297}{14}$$

$= 15 \cdot 235$ pence, amounting, for the day of 10 hours, to $\pounds 0 \cdot 6389$.

When we assume that 1 cubic foot of water, to be evaporated, requires one square yard of heating surface, then the boiler must have as many yards of heat-

ing surface as there are cubic feet to be evaporated, viz., $30 \cdot 471$ square yards; and as by the condition, one square yard of heating surface is to be estimated at $\pounds 5$, the whole cost of the boiler will amount to $5 \times 30 \cdot 471 = \pounds 152 \cdot 35$.

The cost of the engine, being estimated at $\pounds 250$ per square foot of piston, including fixing and building, will amount to $6 \cdot 1697 \times 250 = \pounds 1542 \cdot 425$.

The total yearly expense for engine, boiler, and coals, excluding the wages for the engine-man, oil, tallow, red-lead, &c., and assuming 300 work-days yearly, while the capital sinks 10 per cent., may now be stated thus:

For the engine $\pounds 1542 \cdot 425$ at 10 per cent.	$\pounds 154 \cdot 2425$
For the boiler $\pounds 152 \cdot 35$ at 10 per cent.	15 \cdot 235
For coals, $300 \times 0 \cdot 6389$	191 \cdot 67

Sum $\pounds 361 \cdot 1475$
or $\pounds 361$ 2s. 11·4d.

The formula of De Pambour, here made use of, is, however, not quite correct, for, with an expansion, beginning when the piston has moved through 0·11 part of the stroke, the space to be filled with steam will be a lesser one, so that not only the quantity of water to be evaporated will decrease, but the expense for the boiler too; and as, with this degree of expansion, the diameter of the cylinder will decrease, moreover, the total yearly expense for engine, boiler, and coals, must diminish in about the same ratio. Now, as to our opinion, this problem is not to be explained without the use of integral calculus, and as it is the aim that the solution should have a practical character, we have made the same calculation for four or five different degrees of expansion, varying with $\frac{1}{400} = 0 \cdot 0025$, and we have found that the steam

being cut off when the piston has performed 0.1175 part of its stroke, the yearly expense for engine, boiler, and coals, will be a minimum. The result of our calculation may be stated thus:

Denoting, as before, the same values by the same letters, we find for the mean pressure throughout the whole stroke,

from the formula $\pi' = \frac{l'}{l} \left(1 + e\right) \pi$; $\frac{l'}{l}$ be-

ing 0.1175, $\pi' = 23.87$ lbs. on the square inch, or 3437.7 lbs. on the square foot.

Again, deducting 5.5 lbs. on the square inch for uncondensed steam and friction, the useful pressure on the square foot is found to be 2654.7 lbs.

Now, r being known, we may find as before, the piston's area a , and its velo-

city v , by the formula: $100 = \frac{a r v}{33000}$, and

by substituting the respective values of $a = 0.7854 d^2$ and $v = 128^3 \sqrt{2d}$, we obtain

$d^{2\frac{3}{2}} = \frac{330000}{0.7854 \times 2654.7 \times 128 \times 1.259921} = 9.8477$, and the diameter of cylinder

$d = \sqrt[2\frac{3}{2}]{9.8477} = 2.6654$ feet, or 32 inches, nearly; consequently $l = 2d = 5.3308$ feet,

or 5 feet 4 inches, nearly: velocity of piston per minute $v = 223.605$ feet.

The piston performing 41.944 single strokes per minute, the volume of steam required in the same time will be $(0.1175 + 0.05) \times 5.58 \times 5.3308 \times 41.944 = 208.98$ cubic feet, which, divided by the specific volume of steam at a pressure of 64.7 pounds on the square inch, gives $\frac{208.98}{435.32} = 0.48007$ cubic feet, and adding

thereto $\frac{1}{9}$, the total quantity to be furnished to the boiler will be 0.50534 cubic feet per minute, and per hour $0.50534 \times 60 = 30.3204$ cubic feet. 30.3204 cubic feet of water require to be evaporated $7 \times 30.3204 = 212.2428$ lbs. of coals, at an expense per day of 10 hours, of £0.6317.

The cost of the boiler, with a heating surface of 30.3204 square yards, will be $5 \times 30.3204 = £151.602$, and that of the engine $250 \times 5.58 = £1395$.

Now the total yearly expense, allowing, as before, 300 work-days, will be:

For engine £1395 at 10 pr. ct. £139.5
 " boilers 151.602 at 10 " 15.1602
 " coals, $300 \times 0.6317 \dots \dots 189.51$

£344.1702
 or £344 3s. 4.8d.

	Expansion beginning when the piston has performed 0.115 parts of its stroke.	Expansion beginning when the piston has performed 0.12 parts of its stroke.	No. Expansion.
Mean pressure throughout the whole stroke, in lbs. per square foot	3388.4	3488.3	9316.8
Useful pressure on the piston, in lbs. per square foot	2596.4	2696.3	8524.8
Diameter of cylinder in feet	2.6873	2.6554	1.6142
Length of stroke "	5.3746	5.3108	3.2284
Velocity of piston per minute, in ft. = $128^3 \sqrt{l}$	224.21	223.32	189.17
Cubic feet of water required per hour	30.4428	30.5046	58.981
Pounds of coals " "	213.0996	213.5322	412.867
Cost of boiler, estimated at £5 per square yard of heating surface	£152.214	£152.523	£294.905
Cost of engine, estimated at £250 per square foot of piston	£1417.95	£1384.55	£511.64
Total yearly expense:			
10 per cent. for the capital of the engine	141.795	138.455	51.64
10 " " " boilers	15.2214	15.2523	29.4905
Expense for coals, allowing 300 work-days yearly	190.266	190.65	368.61
	£347.2824	£344.3573	£449.7405

To show the correctness of our calculation, and at the same time the profit of the expansive principle, we give above the results obtained by calculating the expenses for two engines, varying with respect to their degree of expansion $\frac{1}{400}$ part, and the dimensions and yearly expense for an engine, having the same power and working with the same pressure in the boiler, but without expansion at all. The particularities of the calculation being quite the same as before, we have given only the results, as set forth in the preceding table.

Hereby it is shown, that if it were possible in practice to work an engine at the above-stated pressure, and of a power of 100 effective horse-power at a degree of expansion, beginning when the piston has performed $\frac{47}{300} = 0.175$ parts of its stroke, the profit derived from the expansion would amount to £105 10s. 8⁴d., which is, as we believe, the solution of the problem.

H. C. BOSSCHA,
Mechanical Engineer.

Deventer, in the Netherlands,
18th May, 1851.

A BRIDGE OVER THE RIVER ST. LAWRENCE.

To the Editor of Appletons' Mechanics' Magazine and Engineers' Journal.

SIR:—In connection with the project of a railroad from Quebec to Halifax, there has been some talk, of late, of a bridge across the St. Lawrence; and the City Fathers have applied to the Provincial Legislature to cause surveys to be made for the purpose. A suspension bridge, of course, is all that is talked of; but as a bridge on the suspension principle can never do for the heavy traffic of a railway—at least Robert Stephenson, the eminent English engineer, considered it so, in the case of the bridge over the Menai Straits, to carry across the railway of the Chester and Holyhead line, being part of the most direct line between London and Dublin—it becomes important to consider whether a fixed bridge across the river could not be built. The idea is a grand one, there is no doubt, and its realization would certainly be the *ne plus ultra* of civil engineering. No other bridge yet executed can offer the least comparison with the one now contemplated, and that, of course, is owing to the immense depth of water—more than 150

feet at low tide—and the force of the current, to say nothing of the ice in winter, which moves on in such an irresistible way, as to defy almost any force that could be opposed to it. Now, Mr. Editor, the point is, in this case, as indeed in all deep tidal rivers, to make the bays between the piers as large as possible; so that the natural water-way may be as little obstructed as is consistent with the force of the current. One consideration, however, in this case is, that a pier more or less in water 150 feet deep, would be a very grave question of expense.

As to the construction of the piers, I believe the main difficulty would consist in them; and we must of course see, first of all, whether any of the ways heretofore employed for building piers in deep water can be applied in this extreme case. Turning our attention first to *coffer-dams*, on which it is needless to dwell, it will be apparent to any one who will even calculate the thing in his own mind, in a rough way, without having recourse to figures, that their construction would be utterly impossible, and that supposing it were possible, they would cost at least as much as the permanent structure itself.

Now, as to *caissons*, the very idea of one about 200 feet long, and 100 feet broad, and 180 feet high—which height would of course be necessary to allow of the top of the caisson being, when sunk, a few feet above the highest spring tides—would be enough of itself to condemn it directly; but supposing it for a moment to be constructed, look at the immense labor of sinking it to its exact destination. The inside of it, at bottom, would also have to be so strongly braced from side to side, to oppose the immense pressure due to such a depth of water, as to make it more like a piece of crib-work, or a wharf, than like a caisson; and supposing it to be a wooden pier filled in with stone, and sunk to its destination, it would be so very little heavier than the bulk of water displaced, as to afford almost no resistance to its being turned over or displaced by the force of the current.

The only remaining mode then known, and employed in some cases, would be to make an artificial island to build the piers upon, by throwing in loose stone of large dimensions, allowing them to

take their natural slope; and I find by rough calculation that some forty millions of cubic feet would be required for each pier, at a total cost of more than £2,000,000. To say nothing, however, of their cost, such artificial islands would almost choke up half the natural waterway, and the force of the running water would then act so powerfully as to endanger the superstructure, besides causing, probably, an overflow of a very dangerous character to the buildings of the lower part of the city.

Finding nothing, then, in engineering history to offer a precedent for the present undertaking, I have put my own wits to work, and I have devised, I think, a totally original plan for the construction of the piers, which I will now take the liberty to submit.

Having, immediately over the site to be occupied by the pier, constructed a platform of the requisite size, and moored it in such a way that it should always be in the same vertical direction over my pier during the flow and ebb of the tide, I should thereon erect frame-work to the height of say 30 feet, and in the said frame-work leave two vertical openings, or shafts, of about five feet square, at about 50 feet from one another. Having then procured a sufficient number of ten feet length of iron cylinders five feet diameter, turned at the ends, and flanged in such a way as to fit perfectly one into the other, air-tight and water-tight—the flanges being inside, so that the cylinders, when joined, should form a smooth surface outside from top to bottom—I should proceed to let them down through the vertical openings made in the frame-work above alluded to, to guide them in their descent in a truly vertical direction, joining the cylinders end to end, with a coat of red-lead in the joints, and screw-bolts to the flanges, until the first cylinder should touch the bottom or bed of the river, the lower edge of the said first cylinder having been previously made sharp to allow of its easy penetration into the soil. Some contrivance should, of course, be made use of to support the weight of the combined cylinders, until they should be supported by resting on the bed of the river. Having then applied cast-iron caps to the tops of my two long cylinders, or, as I shall now call them, guide-piles, I should, on the pneu-

matic principle of pile-driving, sink them to their destination. Around the two guide-piles as foci, I should then construct, in the shape of an ellipse, the shell of my future pier, in the following manner. The whole of the centre part of my platform, above described, having been purposely omitted, and nothing but an outside rim remaining of sufficient width to work upon—the platform being evidently kept in its position by the moorings and also by the frame-work attached to it holding on to the tops of the guide-piles—I should put together what I shall call the first element, or ring, of the shell, the said element, or ring, being prepared in advance of sheets of wrought-iron to be riveted together like those of a steam-boiler. Now, supposing each sheet of iron to be about ten feet long and two feet high, joined end to end, I should then have a complete ring of two feet high in the shape of an ellipse (and that is, I believe, about the best shape that could be given in this case to withstand the water-pressure and act at the ends as starlings). Having completed the first ring of my shell, I should allow it to sink into the water, and it being well supported to the tops of the guide-piles to regulate the depth of its sinking by means of pulleys and ropes, I should then complete a second ring, which I should add to the top of the first. The two first rings being then riveted together, I should proceed with a third, and let the part of the shell completed sink by degrees, always keeping the top of the last ring so much above the level of the platform as would allow of joining it to the ring next following. Continuing in that way, ring by ring, the shell would at last touch the bottom or bed of the river, and a kind of caisson would have then been completed wherein to erect the stone-work of the pier. The operation of constructing the shell would be absolutely that of constructing a pneumatic pile by adding length to length until the bottom were attained, the only difference being that the shell, or iron caisson in question, might be considered itself as a pile, but one of enormous dimensions (about 150×75 feet, and 180 feet high at high tide), being elliptical instead of circular, and of wrought-iron instead of cast-iron. Now, Mr. Editor, to guide this huge iron casing, in its descent, in a truly vertical

direction, and to enable it when empty to support the pressure due to such a height of water, which in this case would be about 78 pounds, at high tide, per square inch of surface at the bottom part of the casing, diminishing gradually to nothing at the surface, giving a mean pressure of 39 pounds per square inch on the whole surface of the iron shell, which, with the atmospheric pressure, would amount altogether to 44. My plan is to join each ring of the shell (before sinking it) to a wrought-iron or cast-iron ring around the guide-pile by means of rigid cast-iron struts, or braces. The pressure exerted on the outside casing would then be transmitted to the two foci of the ellipse. From the bottom to the top of the iron shell the struts or braces would of course be made proportionately smaller and less numerous, to suit the diminishing pressure of the water; and it will be easily understood that the outside of the guide-piles being made without any projecting flange, the descent of the iron shell attached to it would take place in a truly vertical direction.

The iron shell completed and sunk, I would then apply a top to it and sink it into the soil by the pneumatic principle, having sharpened its lower edge and omitted a sufficient number of the lower struts to enable it freely to descend to a firm bottom.

The casing might then be used as a permanent coffer, and the water having been pumped out of it, it might then be descended into by the workmen and filled with masonry; or it might, if found on calculation to be sufficient, be merely filled in with loose stone, like a wharf, up to the level of low water, which would greatly diminish the cost, and the solid masonry might be then commenced and carried up to its required height.

To give the iron shell the necessary batter to cause it to rest on as large a bed as possible, I should cause each successive ring to be riveted within the one immediately below it; and as that of itself would hardly give enough batter, I would insert between two successive rings a wrought-iron bar of about two inches by one inch, which, combined with the thickness of the iron, would create a succession of offsets forming in the aggregate sufficient batter.

Of course the necessary calculations

should be made to decide upon the exact size and shape of each pier, and the thickness of every part of the iron casing, as well as the size and number of the iron struts, or braces, &c.

I believe now, Mr. Editor, that my mode will not be considered a very clumsy one; and I think it is at least original.

As to the superstructure, the tubular system adopted by Mr. Stephenson over the Menai Straits seems to me to offer the greatest advantages, at least in point of execution; and there is little doubt, I think, but what the span of each tube might be made to reach 750 feet without danger, since the centre tubes of the Menai bridge are 460 clear span, and only deflect three-fourths of an inch with the greatest loads that can be brought to bear on them. The under part of the tubes would require to be at least 100 feet high above high water at spring tides, to offer no impediment to the navigation.

Now, though the tubular system would be the easiest as far as construction is concerned, it is by no means the handsomest nor the cheapest; so that if, as I expect, cast-iron arches could be made of the same span (and plans have been submitted in Europe before this time for cast-iron arches of 500 and 600 feet span), they ought undoubtedly to be preferred. Of course, in the case of such a span as 750 feet, the centering would have to be suspended from the piers in the way proposed by Telford for a bridge of 600 feet span over the Thames, and one of two arches of 450 feet span each over the Menai Straits.

As the height of the hill on each side of the river St. Lawrence is about 180 feet from the river level, and the height of the bridge would only be about 100 feet above the same level, I would enter into or under the hill on the city side through a tunnel which should terminate at such a point within the city as would be well suited for a railway depot, and at the opposite or Point Levi side I should do the same. The bridge, of course, would be accessible to foot passengers and all kinds of vehicles, by inclined planes, from the lower town upwards to the level of the bridge, and from the upper town downwards to the same level.

The St. Lawrence is about 4000 feet

across at high tide, and the two abutments or termini of the bridge would be at about 6000 feet from one another. The greatest depth at low water is supposed to be between 150 and 180 feet. I am now making a complete survey and taking the soundings and borings, etc., and mean to prepare a set of plans and estimates for my own satisfaction, to present to the Legislature of the province.

I cannot terminate without saying a few words of your most valuable and useful Magazine. It certainly does fill up a blank long regretted in scientific and mechanical literature. It supplies one at a very moderate cost with a knowledge of all that is going on daily in the engineering world. I admire the utility of the articles entitled *Mechanics for the Million*, and certainly agree with the author of the articles on pneumatic pile-driving, in saying that the adaptation of the atmospheric pressure to the driving of piles is one of the most beautiful that can well be conceived. It certainly does render possible things heretofore impossible, and who knows but what that very discovery may almost of itself render possible such a marvel as a bridge over the St. Lawrence, the mightiest river on the globe?

A SUBSCRIBER.

Canada East.

U. S. STEAMER "CORWIN."

For Appletons' *Mechanics' Magazine and Engineers' Journal*.

THE "CORWIN" is a small steamer just completed by Merrick & Son, of Philadelphia, for the Treasury Department. She is intended for the use of the Coast Survey, to obtain soundings, &c.

$55.4 \times 18 \times 60 = 59832.00 = \text{speed of centre of reaction of paddles per hour, in feet.}$

$10 \times 5280 = 52800.00 = \text{" vessel per hour, in feet.}$

$7032.00 = \text{slip of the centre of reaction of paddles per hour, in feet,}$
or 11.75 per cent.

The loss of power by the oblique action of the paddles on the water, calculated as the squares of the sines of their angles of incidence on the water, is 19.18 per cent.

The power developed by the engine, as ascertained by indicator diagram taken for the foregoing mean boiler steam pressure of 10 pounds per square inch above the atmosphere, and 36 strokes of

Hull.—Length between perpendiculars, 125 feet; extreme beam, 24 feet; depth of hold, 10 feet; measurement burden, 315 tons; mean draught of water, 8 feet.

Engine.—One steeple engine (with single piston-rod). Diameter of cylinder, 50 inches; stroke of piston of ditto, 4 feet; space displacement of piston of ditto per stroke, 54.54 cubic feet. Diameter of air-pump, 21 inches; stroke of piston of ditto, 4 feet; space displacement of piston of ditto per stroke, 9.62 cubic feet. Proportion of space displacement of air-pump piston to that of cylinder piston, 1.00 to 5.67.

Side Paddle-Wheels.—Of the common radial kind; 18 feet 8 inches diameter to outside of exterior ring; 18 feet diameter from outside to outside of paddles; length of paddle, 5 feet 6 inches; breadth of paddle, 20 inches; mean immersion of lower edge of paddles, 3 feet 8 inches; number of paddles in each wheel, 20; number of paddles in water (both wheels), with one in a vertical position, 5. The paddle-wheel is of the overhung kind; that is, not having an outboard bearing on the guard.

Performance.—The "trial trip" of the "Corwin" took place August 12, 1851, in the Delaware River; her speed was 10 miles per hour; mean steam pressure in boiler above atmosphere, 10 pounds; vacuum in condenser, per gage, $24\frac{1}{2}$ inches of mercury; throttle $\frac{1}{8}$ open; number of revolutions of the wheels per minute, 18.

The slip would, therefore, be as follows: the circumference of the centre of reaction of the paddle, ascertained for the above speed of vessel and immersion of paddle being 55.4 feet.

the steam-piston per minute, is as follows:—the mean effective steam pressure on the piston being, per diagram, 14.35 pounds per square inch;—

$$\frac{1963.5 \times 14.35 \times 144}{33000} = 122.95 \text{ h. power.}$$

Allowing $1\frac{3}{4}$ pounds steam pressure on the piston per square inch for the power required to work the engine alone, over-

come the load on the air-pump, &c., we have 12.12 per cent. of the total power thus absorbed; and taking the coefficient of friction at 0.075, as established by the latest experiments of Morin, for the friction of the load, and taking for the total power applied to the paddle-wheel shaft

the total power developed by the engine, less the power absorbed in working the engine alone, we have for the power absorbed by the friction of the load 6.59 per cent. of the total power of the engine.

Collecting the above figures, we shall have the following

**Disposition of the Power in the "Corwin."*

Slip of the centre of reaction of the paddles	11.75	per cent., or	14.45	horses p.
Oblique action of paddles	19.18	"	23.58	"
Working engine alone	12.12	"	14.90	"
Overcoming friction of load	6.59	"	8.10	"
Leaving to be utilized in the propulsion of the vessel	50.36	"	61.92	"
Totals	100	"	122.95	"

Boilers.—The boilers were two in number, of the kind known as "Montgomery's patent," that is, with vertical tubes containing the water, the fire being applied to the outside of the tubes; the fire compartment being divided vertically in two portions by an iron plate diaphragm, the flame passing direct from the

furnace through the upper portion, and returning through the lower portion.

The boilers contain, in the aggregate, 1100 square feet of heating surface and 48 square feet of grate surface. I am in possession of no more of their details, nor of their consumption of fuel. Their proportions were as follows:

Proportion of heating to grate surface, 22.92 to 1.00.

Square feet of heating surface per cubic foot of cylinder, 20.17.

With these proportions, the boilers would only furnish steam of 10 pounds boiler pressure above the atmosphere, the piston making 38 strokes per minute, the steam being cut off at half stroke.

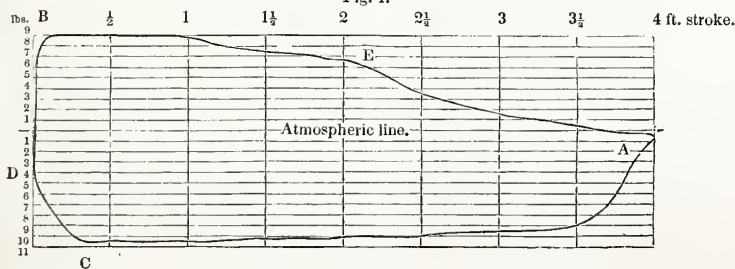
The cut-off valve was a poppet-valve, occupying the same position in the steam-pipe as the old cam-board cut-off, and was worked in a similar manner by a

lever operated by a cam on the main-shaft.

INDICATOR DIAGRAMS.—I give three indicator diagrams taken during the "trial trip." They all exhibit the same features very closely.

Diagram No. 1 was taken with the mean boiler pressure and throttle opening used for the trip. Pressure of steam

Fig. 1.



in boiler per square inch, above atmosphere, 10 pounds; vacuum, per gage, in condenser, $24\frac{1}{2}$ inches of mercury; throttle $\frac{1}{8}$ th open; double strokes of piston per minute, 36.

It will be seen, that although the throttle was only $\frac{1}{8}$ th open, yet the initial pres-

sure of the steam in the cylinder was but 1 pound less than the boiler pressure; and in No. 2, where similarly throttled $\frac{1}{8}$ th, the difference of boiler and cylinder initial pressures are only $\frac{1}{2}$ of a pound, the piston making the same number of strokes per minute. The back-pressure on the

piston, at the maximum condensation, was 4.2 pounds; while in the condenser it was, by gage, 2.45 pounds, being a difference of 1.75 pounds.

All three of the diagrams show the initial pressure of steam in the cylinder to be held for about one-fourth of the stroke, after which a "wiring" of the steam takes place up to the point of cutting off, where the cut-off valve closes and the expansion curve commences.

The corresponding steam and exhaust valves, being both poppet-valves, and operated by the same lifting-rod, were opened and closed at the same moment of time; by reference to the diagrams, it will be perceived that neither the steam nor exhaust valves had any lead, in fact they had what might be called an *inverted* lead; that is, the piston was upon its return stroke before the valves opened. The piston had proceeded about one inch, viz., to A and B, on the return stroke

before the steam and exhaust valves opened. The exhaust-valve also closed too soon, viz., at c, when the piston had still three inches of its stroke to perform, causing the confined steam in the cylinder to "cushion," or be compressed, as shown by the line c d.

The cut-off valve closed at half stroke of the piston, or at E on the diagrams: the expansion curve from E towards A shows a greatly less reduction of pressure than would be due to the law of Mariotte, which makes the pressures of elastic fluids inversely as the spaces into which they are expanded; but in the particular case under consideration, the effect of the expansion is varied from this law, *apparently*, on the diagram, by reason of the additional effect produced by the expansion of the steam in the cylinder passages, valve-chests, and side-pipes, besides the very probable leak in the cut-off and steam valves.

Fig. 2.

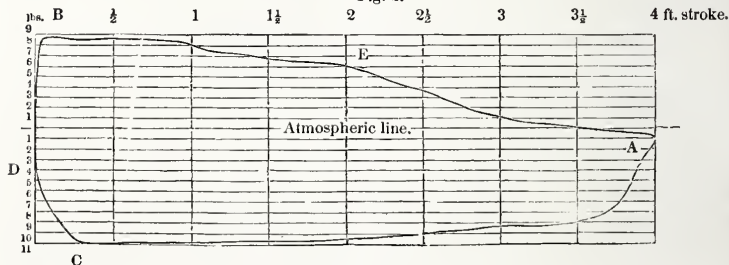


Diagram No. 2 was taken with boiler pressure 9 pounds per square inch, per gage, above the atmosphere; vacuum in

condenser, per gage, $24\frac{1}{2}$ inches of mercury; throttle $\frac{1}{8}$ th open; double strokes of piston per minute, 36.

Fig. 3.

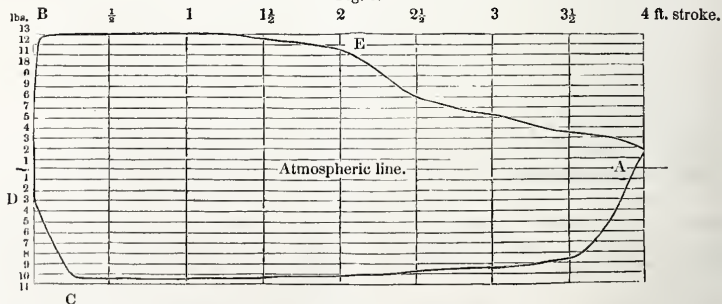


Diagram No. 3 was taken with boiler pressure 14 pounds per square inch, per gage, above the atmosphere; vacuum in

condenser, per gage, $24\frac{1}{2}$ inches of mercury; throttle $\frac{1}{4}$ th open; double strokes of piston per minute, 40. B. F. I.

NOTES ON THE U. S. STEAMER "PRINCETON."

BY B. F. FISHERWOOD, CHIEF ENG. U. S. NAVY.

For Appletons' Mechanics' Magazine and Engineers' Journal.

Continued from page 567.

In the combustion of bituminous coal, *time* is the important element, and a slow rate of combustion with low velocity of draught is necessary for obtaining high evaporative results, and for the following reasons, viz.: The bituminous portion of the coal is volatilized and separated from the fixed carbon part at a lower temperature than is required for its ignition, that is, than is required for its chemical union with oxygen. In this gaseous state, occupying the furnace and flues of the boiler, it can only be ignited by being mixed with atmospheric air, at a sufficiently high temperature; the element of *time* is therefore doubly important: *first*, to allow the gases to become intimately mixed with the atmospheric air; *second*, to allow them to acquire the necessary high temperature. If now, by means of a powerful draught, the gases, having only the low temperature due to their volatilization, be driven so quickly through the flues, and out of the chimney of the boiler, as not to allow them *time* enough to acquire the proper temperature for combustion, and to have the proper mixing with atmospheric air, a great loss of effect must inevitably follow. For the economical combustion, then, of bituminous coal in generating steam, there should be a slow rate of burning, or a small amount consumed per unit of time per unit of surface; and this slowness of combustion should not be effected by smallness of calorimeter, or any choking of the draught; on the contrary, it is essential that the products of combustion have plenty of space to pass off freely as soon as generated, and the low velocity of draught should be obtained by giving such an amount of heating or caloric absorbing surface as, by reducing the temperature of the gases gradually in their approach to the chimney, would lessen their velocity of exit by the lessened difference between their temperature and that of the external atmosphere. Another obvious advantage from this arrangement is, that not only is more caloric evolved from the combustion of the fuel, but also that more of that caloric is taken up by the water to be evaporated.

In the combustion of anthracite coal, however, the above general observations do not apply. Considering the principal portion of the anthracites to be fixed carbon, there will of course be no volatilization of bitumen at a lower temperature than what is required for the ignition of the fixed carbon; the coal will consequently remain unchanged until the temperature is sufficiently high for its combustion, that is, for the combustion of its fixed carbon: a forced draught cannot, therefore, carry off the fuel before it is ignited, and in this view velocity of draught is comparatively unimportant. Again, combustion with the anthracites is effected solely by the contact of the air with their solid surfaces; there is therefore no mixing to be done, and consequently no time required to do it in. Here, then, under two important conditions, great velocity of draught, which is highly detrimental to the economical combustion of bituminous, is unimportant in the combustion of anthracite coal.

Further, with the ordinary dimensions of boiler-furnaces, a strong draught is advantageous in the burning of anthracite, which requires a high temperature for ignition. This high temperature can only be sustained either by the burning of large masses if a slow draught be used, or by a rapid draught if small masses be used; and the latter is the case in the furnaces of steam-boilers. The only manner, then, in which rapidity of draught may be detrimental to the economical use of anthracite is where it does not give *time* enough for the water to take up the caloric: with a sufficient proportion of heating to grate surface, this can be obviated; and although this proportion was considerably too small in the "Princeton" boilers, yet, owing to the absence of other causes, of waste operating with bituminous coals in other boilers, the economical evaporation reached the ordinary standard.

The use of bituminous coal in the boilers of the "Princeton" was occasionally essayed when none other could be obtained, but with very little success, as it was impossible to generate any thing like the proper amount of steam by a natural draught; and if it was forced by the blowers, the gases were driven out of the chimney before they were consumed, and nearly the same lack of steam was

experienced as before, with an enormous consumption of fuel.

The propeller of the "Princeton" was so arranged with couplings on the shaft, that it could, at will, be disconnected from the engine, and the vessel sailed under canvas alone; of course dragging the propeller through the water, the propeller turning by the reaction of the water upon the blades. The speed of the "Princeton," thus sailed under canvas alone, and dragging her propeller, was of course less than it would have been had there been no such drawback; but even with that, the speed was very respectable, compared with other sailing-vessels. The U. S. frigate "Potomac"

being ordered from Pensacola to Norfolk for repairs, the "Princeton" accompanied her as an escort, using her sails only. On the occasion of this passage, it was found that the "Princeton," with sail set to top-sails, could easily keep way with the "Potomac," that vessel having sail set to top-gallants, and this not in any one particular point of sailing or strength of wind, but as a general average for the whole passage.

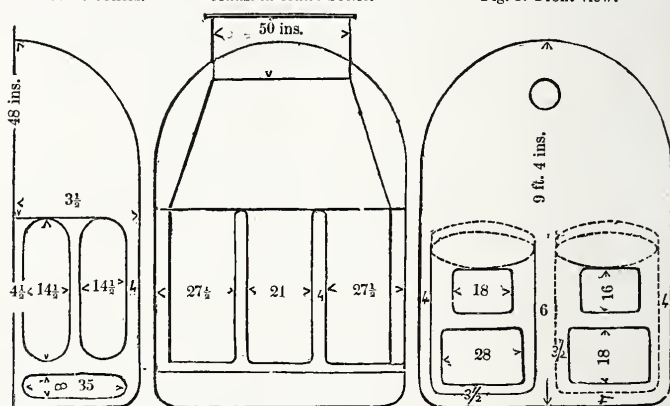
A short race was tried between the "Princeton" and the U. S. brig "Somers" (considered an extraordinary fast sailer), June 17, 1846, off Vera Cruz. Both vessels were standing on the same tack, close-hauled by the wind, and separated

BOILERS OF U. S. STEAMER "PRINCETON."

Fig. 1. Section through flues in side-boilers.

Fig. 2. Section showing back conns. in centre-boiler.

Fig. 3. Front view.



but by a few hundred feet; the brig had sail set to royals, the "Princeton" to top-gallants; the wind being a fine working top-gallant breeze, and the sea perfectly smooth. After speaking the "Princeton," the brig went about and stood on her course with the wind abeam; the "Princeton" now tacked, and followed her, the brig being about 400 yards ahead, when the "Princeton" was fairly on her course. In fifteen minutes the "Princeton" was on her weather-beam square up with her and shooting ahead fast, when the race was discontinued. The speed of the "Princeton" during this short race was $8\frac{3}{4}$ statute miles per hour, and for the last few minutes gained on the brig, at the rate of about 100 feet per minute.

During the race, the "Princeton" had steam on the centre boiler only, at a pressure of 6 lbs. above the atmosphere, the throttle was $\frac{1}{16}$ open, the propeller making 17 revolutions per minute. The pitch of the propeller being 32.44 feet, its speed per hour was $32.44 \times 17 \times 60 = 33088.8$ feet.

Speed of vessel per hour $5280 \times 8\frac{3}{4} = 46200.0$ feet; consequently the propeller, so far from assisting, was retarding the speed of the vessel.

The draught of water of the "Princeton," during the race, was 18 feet 8 inches aft, and 15 feet 4 inches forward.

During the passage from Pensacola to Vera Cruz, with a mean draught of vessel, July 30, 1846, the "Princeton" made under sail alone, with the propeller un-

coupled and dragging, $4\frac{1}{2}$ knots per hour; sail set to royals; very light wind abeam and smooth sea. The propeller made 11 revolutions per minute by the reaction of the water on the blades.

July 31, 1846, the "Princeton" made 6 knots with sail alone set to royals, wind moderate and free, sea smooth; the uncoupled propeller making $14\frac{1}{2}$ revolutions per minute.

BOILERS OF THE U. S. STEAMER "PRINCETON."

Fig. 4.

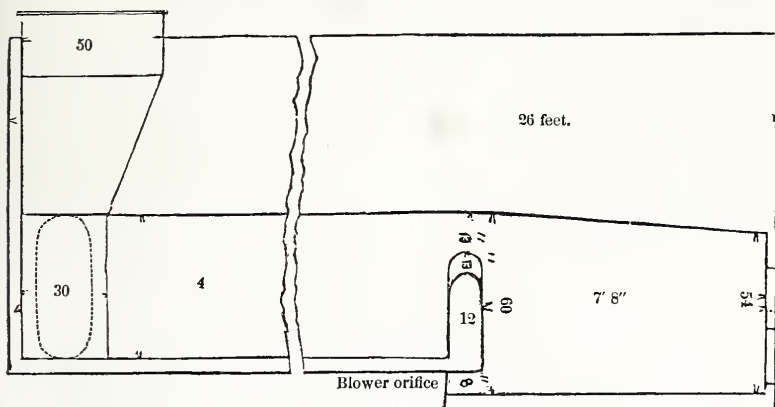


Fig. 5.

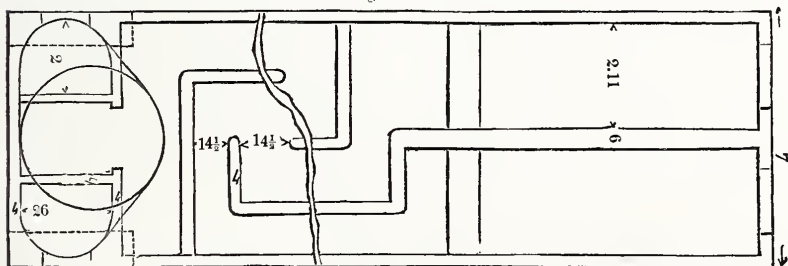
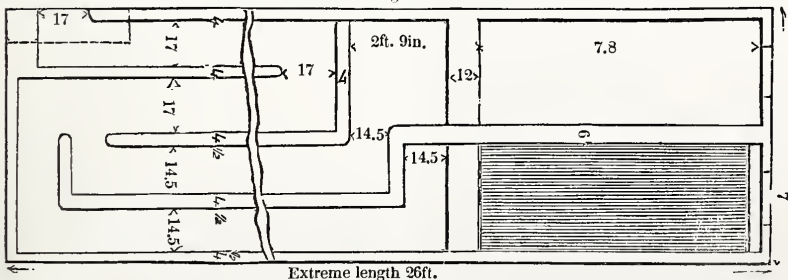


Fig. 6.



During the occupation of Tampico by the naval force in the war with Mexico, the "Princeton," in common with a number of frigates and corvettes, lay off in

the open roadstead at anchor for several weeks in the winter months. While there, the squadron was suddenly struck by a violent "norther," which obliged

the vessels to slip their cables and put to sea. The "Princeton," on this occasion, was the only vessel that carried top-sails, and she beat out to windward of the squadron, under sail alone, dragging her propeller, though at the time in light trim.

But the great value of the "Princeton" as a blockading vessel was conclusively shown during the Mexican war, when for a long time she blockaded the port of Vera Cruz alone, and not a single vessel succeeded in running the blockade, though many attempted it. This was an amount of duty which could not be as well performed by the *three* sailing-vessels together that ordinarily relieved her.

While thus blockading, the "Princeton" would lay off and on before the city under easy sail, with steam on the centre boiler only, and the fires banked in its two furnaces. In this state of things, the moment a sail was descried on the horizon, the fires were spread, blowers started, and the vessel under sail, and steam was in chase in ten minutes from the word. To show the vessel's speed under these circumstances, I will state, that on June 22, 1846, during a chase, she made $3\frac{3}{4}$ knots under steam alone, at load draught, with 12 lbs. of steam per square inch in centre boiler only; vacuum in condenser 23 inches mercury, revolutions of propeller $16\frac{1}{2}$ per minute, throttle $\frac{1}{16}$ open, smooth sea and light head wind, the vessel steaming directly head to wind, consumption of coal at the rate of 700 pounds per hour.

In the month of June, 1846, from the 3d to the 19th, being 16 days of continuous blockading with steam up, the whole consumption of coal was only 32,960 lbs., or 2060 lbs. per 24 hours. During this

time the vessel averaged in chase 8 hours out of each 24, the centre boiler only being used.

The temperature of the water in the starboard and larboard boilers, owing to radiation from the centre boiler and leakage through the stop-valves, was respectively 160° and 140° F.; the temperature of the coal-bunkers immediately over the boilers was 104° F.; the temperature of the engine-room, 115° F.; temperature on deck, 90° ; temperature of sea-water, 80° F.; temperature of steam in the boilers, 245° F.

The boilers of the "Princeton" were covered with one thickness of felt, over that came a coat of sheet-iron, followed in turn by a casing of wood, which was again covered with sheet-iron; against this last the coal was thrown, as the boilers formed one side of the bunkers.

With full load of provisions and fuel, but with the boilers empty, the vessel's draught of water was, forward, 16 feet 1 inch; aft, 19 feet. With the boilers filled, the draught was 16 feet 7 inches forward and 19 feet 4 inches aft.

The mean speed of the "Princeton," in the Gulf of Mexico, during 1845 and 1846, under steam alone, in calms and smooth sea, was, for a mean of 304 hours steaming, 6'328 knots per hour: mean revolutions of propeller, 22'58 per minute; mean pressure of steam in boiler above atmosphere, $11\frac{3}{4}$ lbs., cutting off at $\frac{3}{8}$ ths from commencement of stroke; vacuum in condenser, 23 inches of mercury; throttle $\frac{1}{2}$ open; consumption of anthracite coal per hour, 1293 pounds. Taking the knot at $6082\frac{2}{3}$ feet, the pitch of the propeller being 32'44 feet, its slip would be as follows:

$$32'44 \times 22'58 \times 60 = 42949'712 = \text{speed of propeller per hour in feet,}$$

$$6082\frac{2}{3} \times 6'328 = 38491'115 = \text{speed of vessel} \quad " \quad "$$

$$\frac{4458'597}{38491'115} = \text{slip of propeller} \quad " \quad "$$

or 10'38 per cent.

The mean speed of the "Princeton," in the Gulf of Mexico, during 1845 and 1846, was, under steam and sail set to top-gallants, smooth sea and moderate wind free, for a mean of 371 hours, 7'068 knots per hour; mean revolutions of propeller, 23'3 per minute; mean pressure of steam in boiler above atmos-

phere, $10\frac{3}{10}$ lbs., cutting off at $\frac{3}{8}$ ths of the stroke of piston from the commencement; vacuum in condenser, $22\frac{6}{10}$ inches of mercury; throttle $\frac{1}{2}$ open; consumption of anthracite coal per hour, 1264 lbs. Taking the knot as before, as $6082\frac{2}{3}$ feet, the slip of the propeller will now be as follows:

$32.44 \times 23.3 \times 60 = 45351.120$ = speed of propeller per hour in feet,
 $7.068 \times 6082\frac{2}{3} = 42992.288$ = speed of vessel “ “

2358.832 = slip of propeller “ “

or 5.20 per cent.

It will be observed that the use of sail, on an average, has reduced the slip of the propeller one-half, and increased the speed of the vessel $11\frac{7}{10}$ per cent., almost exactly the same quantity of fuel being used in both cases; the number of revolutions of the propeller per minute and the steam-boiler pressure being slightly increased, and the opening of the throttle slightly diminished.

The maximum performance of the “Princeton” at sea was, under sail and steam, $9\frac{1}{2}$ knots per hour. She made this speed for 4 consecutive hours, Sept.

$32.44 \times 30 \times 60 = 58392.00$ = speed of propeller per hour in feet.
 $6082\frac{2}{3} \times 9\frac{1}{2} = 57785.33$ = speed of vessel “ “

606.67 = slip of propeller, “ “

or 1.104 per cent.

September 14, 1846, the “Princeton” averaged, for 7 hours steaming, $8\frac{1}{2}$ knots per hour, with sail set to top-gallants; fine working breeze and ordinary sea; steam-pressure in boiler, $13\frac{1}{2}$ lbs. per square inch above atmosphere, cutting off at $\frac{3}{8}$ ths from commencement; revolu-

15, 1846, in the Gulf of Mexico. Steam-pressure in boiler, 14 lbs. per square inch above atmosphere; revolutions of propeller per minute, 30; vacuum in condenser, 23 inches of mercury; consumption of anthracite coal per hour, 2000 lbs.; throttle $\frac{1}{2}$ open. Breeze strong and free; sail set to top-gallants. Temperature of engine-room, 122° F.; of coal-bunkers, 101° ; of hot well, 113° ; of sea-water, 81° ; on deck, 85° . Ordinary sea. The slip of the propeller in this case, calculated as before, would be as follows:

tions of propeller, 28 per minute; vacuum in condenser, 23 inches of mercury; throttle $\frac{1}{2}$ open; consumption of anthracite coal per hour, 2000 lbs. Temperatures the same as in the foregoing paragraph. The slip of the propeller, calculated as before, would be as follows:

$32.44 \times 28 \times 60 = 54499.20$ = speed of propeller per hour in feet,
 $6082\frac{2}{3} \times 8\frac{1}{2} = 51702.67$ = speed of vessel “ “

2796.53 = slip of propeller “ “

or 5.13 per cent.

(To be continued.)

HENRY GRISSELL'S (of the Regent's Canal Iron-Works) IMPROVEMENTS IN COATING METALS WITH OTHER METALS. Patent dated January 11th, 1851. Enrolled July 10th, 1851.

THE patentee's improvements in coating metals with other metals are as follow:

Coating Iron with Zinc.—For this purpose the patentees use a bath or vessel of iron, or other suitable material, in which, by means of heat, they melt the zinc, and on the surface of the melted zinc place a thick layer of chloride of zinc (prepared by dissolving zinc in muriatic acid, and driving off the water), or a mixture composed of 8 parts of chloride

of zinc, and 10 parts of chloride of potassium; or a mixture of equal parts of chloride of zinc and chloride of sodium; or a mixture of about equal parts of dry sulphate of zinc and chloride of sodium, or chloride of potassium. When the metal and the salt are in a state of fusion, the iron to be coated with zinc is dipped into the metal, through the covering of fused salt, and becomes coated with zinc. If, however, it is found that a sufficient quantity of zinc has not adhered to the iron, a small quantity of sal ammoniac, in powder, is sprinkled over the iron, which is again dipped into the melted zinc. Under this part of their invention, the patentees claim the use of chloride of zinc applied as above mentioned in the

fused state; also of the mixtures of the various salts above enumerated.

Coating Zinc, Iron coated with Zinc, or other Metal, with a Metallic Alloy.—For this purpose the patentees use a vessel of iron, or other suitable material, in which the alloy is melted. One of the alloys used by them is composed of zinc 10 parts, tin 26 parts, and lead 5 parts. A layer of chloride of zinc mixed with an equal weight of sal ammoniac is kept in a state of fusion on the surface of the metal alloy, the temperature of which must not be carried higher than is sufficient to keep the alloy in a fluid state. The metal to be coated is dipped into the melted alloy, but not allowed to remain therein longer than is absolutely necessary to receive a coating of the alloy. The patentees use also the alloy called "fusible metal," which they prefer to make as follows: bismuth 8 parts, lead 5 parts, and tin 3 parts; alloys of other compositions will do, provided that their melting points is below 400° Fah. The patentees claim the use, in the manner above stated, of the alloys specified and referred to, and of the method above described for coating metals with such alloys.

Coating Iron or other Metal with Tin, or Tin alloyed with Lead.—For this purpose the patentees use a vessel of iron, or other suitable material, in which the tin or alloy is melted, and on the surface of the fused metal lay a stratum of chloride of zinc, mixed with about its own weight of sal ammoniac. The metal to be coated is then dipped into the liquid metal or alloy, until the coating is effected. The patentees state that it will be found advantageous, in the use of this and the preceding process, to dip the metal to be coated several times, in order that it may come in contact often with the layer of fused salt: also advantageous in the preceding process to dip the iron or other metal into a hot and slightly acid solution of chloride of zinc, previous to immersion in the bath of melted metal. The patentees claim, under this head of their invention, the use of a mixture of chloride of zinc and sal ammoniac, forming a saline compound, which is kept in a state of fusion on the surface of the melted tin or alloy, in the process of coating metals with other metals.

Coating Iron or other Metal with Silver, or Alloy of Silver and Copper.—In

this case, the surface of the iron or other metal to be coated is to be first amalgamated in the usual way. The patentees prefer to use, for the amalgamating process, a mixture of 12 parts of mercury, 1 of zinc, 2 of sulphate of iron, 2 of muriatic acid, and 12 of water; the mixture to be heated, and when at 200° Fahr., the iron to be amalgamated is placed in the mixture, and the mercury rubbed on the surface of the iron. The silver, or alloy of silver, is then melted in a crucible, placed in a suitable furnace, and the amalgamated metal is dipped into it until it has acquired a proper coating of the silver or alloy employed.

Under this head, the patentees claim the process of coating iron or other metal with silver, or alloy of silver and copper, by amalgamating the surface of the metal to be coated, and then putting it into the melted silver or alloy.

Coating Iron with Copper, Brass, or any Alloy of Copper, with Zinc, Tin, or Lead.—In this case, the copper or alloy used is melted in some suitable vessel, and on the surface of the melted metal is placed a layer of borosilicate of lead (composed of 112 parts of oxide of lead, 24 of boracic acid, and 16 of silica), and when the metal and the salt are in a state of fusion, the metal to be coated is introduced through the layer of salt into the melted metal, where it is allowed to remain long enough to acquire a coating of the metal. The patentees sometimes coat the iron with zinc, or with tin, or even amalgamate its surface with mercury, in the way above mentioned, and then proceed to dip it into the melted copper or alloy. Another method of coating iron with copper or brass, is that of exposing it to the vapor of chloride of copper, by placing that substance at the bottom of a covered crucible, in the upper part of which is placed the iron to be coated. The crucible is heated to redness, in a suitable furnace, and the vapors of the chloride of copper volatilize and coat the iron with copper. If the iron thus coated with copper be placed in the upper part of a covered crucible, in which metallic zinc, covered with animal and other charcoal, is placed, and heat applied as in the above case, the vapors of the zinc rise, and coming in contact with the copper-coated iron, convert the coating of copper into brass. Instead

of chloride of copper, a mixture of metallic copper and sal ammoniac may be used, or a mixture of oxide of copper, and sal ammoniac.

The patentees claim, under this head of their invention, the use of borosilicate of lead, in a fluid state, over the surface of melted copper or brass, or of the alloys above mentioned, in the process of coating iron by immersion; also the process of coating iron with copper by the action of fused chloride of copper, or the mixtures above named, and of coating with brass by subsequent treatment with vapors of zinc, as above mentioned.

—*London Patent Journal.*

THE MARINE STEAM FORCE OF GREAT BRITAIN.*

GREAT BRITAIN possesses one hundred and forty-seven steam-ships, including three in Canada, and thirty-two iron steamers, eleven ranging from 1547 to 1980 tons. Of these, four were formerly 76-gun ships, and have now engines of 450 horse-power. The largest, the *Simoom*, of 1980, has only 350 horse-power; the *Terrible*, however, of 1850, has engines of 800 horse-power; the *Termagant*, of 1547, has engines of 620 horse-power; while the *Arrogant*, of 1872, has only 360 horse-power; the *Retribution*, of 1641, has 400 horse-power. One of the above eleven, the *Penelope*, was a 46-gun frigate. Fifteen from above 1200 and under 1500 tons, twenty-seven above 1000 and under 1200, twenty-three above 700 and under 1000, nine above 500 and under 700, twenty-seven from 250 and under 500, twenty-two from 150 and under 250, four from 42 to 149; three on the lakes of Canada, one of 406 and of 90 horse-power, and one of 750 and of 200 horse-power; twelve packets, 237 to 720, some of which are very fine vessels; 58,643 in commission, and 58,501 tons in ordinary. Of the steam-ships, there are built of iron—the *Simoom*, 1984; the *Vulture*, 1764, both 350 horse-power; the *Greenock*, 1418, and 550 horse-power; the *Birkenhead*, 1405, and 556 horse-power; the *Niagara*, 1395, and 350 horse-power; the *Trident*, 850, and 350 horse-power; the *Antelope*, 650, and 264 horse-power;

the packet *Lizard*, 340, and 150 horse-power; the *Bloodhound*, 378, and 150 horse-power; the *Grappler*, 557, and 220 horse-power; the *Sharp-shooter*, 503, and 202 horse-power; the *Harpy*, 344, and 200 horse-power; the *Myrmidon*, about 350, and 180 horse-power; the *Sphinx* and *Fairy*, about 300, and 110 horse-power; and four other smaller vessels, of 20 to 9 horse-power. Six of the packets are built of iron. Screw-steamers on the stocks, viz., one 80-gun at Devonport, one 80-gun at Woolwich, and one 80-gun at Pembroke; in all, one hundred and fifty steam-ships. Then there is the mercantile steam power. The steam-vessels registered in the port of London on the 1st of January, 1851, were three hundred and thirty-three: one hundred and seventeen under 100 tons, sixty-four from 100 to 200, twenty-six from 200 to 250, twenty-seven from 250 to 300, sixteen from 300 to 350, nine from 350 to 400, ten from 400 to 450, eight from 450 to 500, three from 500 to 550, seven from 550 to 600, three from 600 to 650, six from 650 to 700, two from 700 to 750, five from 750 to 800, three from 850 to 900, one from 900 to 950, eight from 1000 to 1500, six from 1500 to 1800, eleven from 1800 to 2000, and one above 2000 tons. In Liverpool there were ninety-two steam-vessels: twenty under 100 tons, forty-nine from 100 to 200, twelve from 200 to 400, six from 400 to 600, three from 600 to 800, one of 1300 tons, and one of 1609 tons. At Bristol there were thirty-one steam-vessels: eleven under 100 tons, fourteen above 100 tons and under 300, three from 300 to 500, two from 500 to 600, one (*Great Britain*) of 2936. At Hull there were thirty-four steam-vessels: eight under 100 tons, seven from 100 to 200 tons, eight from 200 to 400, eight from 400 to 700, two from 700 to 1000, and one of 1320 tons. At Shields there were fifty steam-vessels: forty-eight under 100 tons, one of 388, and one of 106 tons. At Sunderland there were thirty-two steam-vessels under 100 tons. At Newcastle-upon-Tyne, there were one hundred and thirty-eight steam-vessels: one hundred and thirty under 100 tons, six from 100 to 300, two from 300 to 500. At Southampton there were twenty-three steam-vessels: nine under 100 tons, nine from 100 to 300, five from 300 to

500. At Glasgow there were eighty-eight steam-vessels: fourteen under 100 tons, forty-eight from 100 to 300, sixteen from 300 to 700, three from 700 to 1000, five from 1000 to 2000, two from 2000 to 2500. At Leith there were twenty-three steam-vessels: eight under 100 tons, twelve from 100 to 500 tons, three 500 to 1000 tons. At Aberdeen there were sixteen steam-vessels: three under 100 tons, four from 100 to 300, three from 300 to 600, five from 600 to 1000, and one of 1117 tons. At Dublin there were forty-four steam-vessels: three under 100 tons, fifteen from 100 to 300, thirteen from 300 to 500, thirteen from 500 to 800 tons. At Dundee there were ten steam-vessels: five under 100 tons, two from 100 to 300, three from 500 to 800. At other ports there were two hundred and seventy steam-vessels: one hundred and thirty-nine under 100 tons, sixty-one above 100 and under 250, forty-five from 250 to 500, twenty-two from 500 to 750, and three from 750 to 1000.

ON THE VALUE OF VARIOUS KINDS OF
COAL FOR STEAM PURPOSES.*

SOME three or four years since, the Government appointed a commission, consisting of Sir Henry de la Beche, F.R.S., and Dr. Lyon Playfair, F.R.S., to examine and report upon the coals suited to the steam navy. The first and second reports had already appeared, but it was not until recently that the third and last report has been presented to Parliament. As the subject is one of interest, not only to the steam navy, but also to manufacturers employing steam-power, we will give a very condensed account of the results obtained by the Commissioners, in their examination of the various coals submitted to them.

Although the analysis of a coal shows generally, that the quantities of carbon and hydrogen which it contains materially regulates its economic value, still, there are marked exceptions to this rule, showing, that in all inquiries as to the real value of coal for fuel, its economic value as to its evaporative power, by actual trial under the boilers, should be ascertained.

The coals of the Newcastle district

are, in general, of very different composition from the Welsh coals. They are characterized by containing a smaller quantity of carbon, but a larger amount of hydrogen. This latter element exercises, in this case, a very essential importance in their heating powers, and must not be neglected in comparing the analytical with the economic results. As a general rule, subject to marked exceptions, the practical value of the coal rises with the increase of these two combustible elements. Nevertheless, the mechanical conditions of a coal very frequently modify the practical result to an extent which was scarcely to be expected. The physical condition of a coal, according as it facilitates or opposes the entrance of air for combustion, produces a most marked influence in its evaporative powers, and often determines the practical results obtained from it, more than the composition of the coal itself. It is, therefore, not a safe guide to rely wholly on the analysis of a coal, unless, at the same time, practical experiments are found to coincide with the approximative value indicated by analysis.

The examination of 37 varieties of Welsh coal show that the weight of water evaporated from 212° by one foot of coal, varied from 608·78 lbs., the highest, to 392·2 lbs., the lowest: 500 lbs. being about the average. The examination of 18 varieties of Newcastle coal showed that the weight of water evaporated from 212°, by one cubic foot of coal, varied from 529·34 lbs., the highest, to 325·25 lbs., the lowest: the average not exceeding 420 lbs.

The composition of Derbyshire coals, now brought to London by railway, and consumed to a considerable extent in the metropolis, is in many respects similar to those from Newcastle, but in general they appear to contain rather a smaller quantity of carbon. The weight of water evaporated from 212° by one cubic foot of these coals is about 350 lbs.

Upwards of 28 varieties of Lancashire coal were also examined, and their composition determined; but in those, as in the other cases alluded to, the same exceptional differences, due to the variations in their mechanical conditions, are observable, although, generally, the analytical value corresponds with that ob-

tained by the boiler experiments. The weight of water evaporated from 212° by one cubic foot of coal, was found to be 445·91 lbs. in the highest, and 326·11 lbs. in the lowest case: the average being about 400 lbs.

An examination of a few Scotch coals showed that on the average of eight varieties, the weight of water evaporated from 212°, by one cubic foot of coal, was about 400 lbs.

The average value of the coals obtained from different localities are expressed in the following table; and although the averages are deduced from an unequal number of observations, still these are, in most cases, sufficiently large to give an approximative average of value; to this we add the results obtained from an examination of six varieties of "patent coals."

LOCALITY.	Evaporating power, or number of pounds of water evaporated from 212° by 1 lb. of coal.	Rate of evaporation, or number of pounds evaporated per hour.	Weight in pounds of one cubic foot of coal, as used for fuel.	Space occupied by one ton in cubic feet.
Average of				
37 samples from Wales	9·05	448·2	53·1	42·71
17 " from Newcastle	8·37	411·1	49·8	45·3
28 " from Lancashire	7·94	447·6	49·7	45·15
8 " from Scotland..	7·70	431·4	50·0	49·99
8 " from Derbyshire	7·58	432·7	47·2	47·45
<i>Patent Coals.</i>				
Warlich's.....	10·36	457·84	69·05	32·44
Livingstone's.....	10·03	483·95	65·6	34·14
Lyon's.....	9·58	409·1	61·1	36·66
Wylam's.....	8·92	418·89	65·08	34·41
Bell's.....	8·53	549·11	65·3	34·30
Holland and Green's...	7·59	470·0	64·8	34·56

REMARKS ON THE INEFFICIENCY OF ORDINARY SAFETY-VALVES AS PREVENTIVES OF EXPLOSIONS IN STEAM-BOILERS, WITH PROPOSALS FOR IMPROVEMENTS IN THE SAME.

For Appleton's Mech. Mag. and Eng. Journal.

WHATEVER may be the ultimate causes of explosions in steam-boilers—to whatever defect in construction, workmanship, or management these disastrous occurrences may be individually traced, it is certain that in all cases where violent disruption has taken place, the immediate cause has been pressure, and nothing but pressure.

Ingenuity has been taxed and experimental science has been ransacked, to deduct from ascertained facts in connection with steam, the means of remedying the results of its dangerous properties; while with the same laudable intentions theories without number have been advanced, seeking to throw a light on mysterious agencies other than experiment has confirmed, and to expound hidden properties which never existed.

Although, however, nothing comparatively has been effected—although explosions still take place, and in all probability will continue to take place, it is not too much to affirm that the present state of our knowledge on this subject, limited as it may be, is, nevertheless, amply sufficient to obviate even the chance of danger; that even the simple knowing of the fact that pressure alone, from whatever source evolved, is the immediate forerunner of every explosion, ought in itself to be a sufficient guarantee for its prevention.

Precaution, under our existing knowledge, is the only preventive, but it is a safe one; precaution in construction, precaution in workmanship, and precaution in attendance.

As, however, this latter is not always to be depended upon, and as the most careful engine-tender may sometimes be at fault, it follows that, in the construction of boilers, combined with sound workmanship, too great attention cannot be paid to the means of rendering them so perfect in their self-adjusting action as to defy the

consequences of the most reckless carelessness.

Since, therefore, it is an axiom not to be controverted, that a boiler cannot burst or explode in the ordinary manner without internal pressure, it may be fairly submitted that if we can devise any precautionary method whereby it can be relieved from that pressure as fast, or faster, than it is evolved from any undue cause, the means of perfect security will in all cases be obtained, except when some most inordinate and preposterous defect exists.

To effect this desirable purpose, the ordinary safety-valve has been devised; and as it is a most obvious and simple contrivance, so it would appear at first sight to be most effective; but it is not too much to believe that, for the very reason of its being obvious and simple, it has not sufficiently claimed the attention of engineers. That it is not so effective as is generally supposed, and that it is capable of great improvement, I will now attempt imperfectly to show.

Fig. 1.

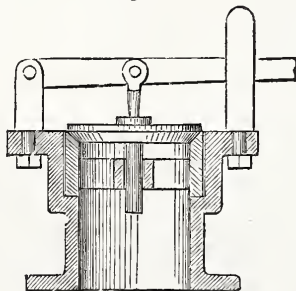
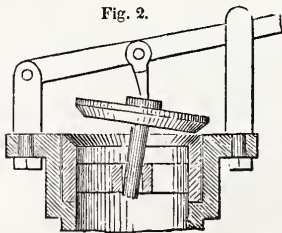


Fig. 2.



The most common safety-valve now in use for boilers working much above atmospheric pressure, is the one shown in fig. 1, being the ordinary weighted lever-valve.

In some cases, however, the lever is discarded, and weights are placed perpendicularly over the valve, or suspended to it inside the boiler—preferable modes in all respects where compactness and steadiness can be obtained.

In either case the valve itself consists of a flat plate (frequently hollowed out on the under side), having a tale or guide spindle, and bearing with its edges on a brass seat, to which it is ground conically.

With such a valve or valves, or others similar in their more important features, has every boiler been furnished which has exploded since the use of steam-engines became general—a fact which would alone prove that where real danger exists, and when they ought to fulfil their intentions to most purpose, they are of little or no use.

Indeed, it may be confidently asserted, that their utility as safety-valves does not in any great degree extend beyond that of indicating to the attendant any undue increase of pressure that may take place, and giving him the power of blowing off at intervals whatever amount of steam circumstances may require.

Their inutility as self-acting protectors at the critical conjunctures of neglect and danger, would appear evident, and the fault most probably lies in some defect in their construction. It may be said that, by making them of larger diameter, greater security may be afforded; but this is inconvenient, and it is moreover quite possible that a defect may exist which is common to large ones as well as small.

Now it seems highly probable that a most serious defect does exist, and lies in this simple fact, that the plate constituting the valve is *made flat or hollowed out on the under side*.

It cannot be doubted, on due consideration, that this form of valve is bad, for this simple reason, that any fluid in motion, meeting with an obstacle at right angles to its course, must reverberate upon itself, as is exemplified in Montgolprier's hydraulic ram, and in the bursting of pipes by the reaction of water on sudden stoppage. Thus it is evident, that when the valve is open, the greater portion of steam rushing to its exit will strike against the under side of the valve-plate, and be thrown back in an opposite direction, forming thereby an opposing current to the particles of steam which immediately follow.

That the evil effects of this action are more serious than might be at first imagined, may be shown on reference to a small well-known philosophical instrument first noticed by Clement des Ormes, but originally discovered, I believe, by W. R. Roberts, the eminent machinist of Manchester (Eng.).

Fig. 3.



Fig. 3 represents a small tube A, having attached to one end a flat plate or disk B; C is another loose plate of the same diameter. The top surface of B and the under side of C ought to be both level and somewhat accurately fitting when placed together. If the instrument is now placed perpendicularly, the disk C being placed on the plate B, and the lower end of the tube A be blown into, no force of blast will be able to remove the plate C from its position. The fact is certain, and the reason has been variously explained. Although, however, a true solution is difficult to arrive at, it seems most likely that the action which takes place is very nearly allied to the following.

The air projected up the tube A strikes forcibly, in the first instance, against the top plate C, tending to lift it from its state of rest, which it certainly does to a slight extent; no sooner has this taken place, however, than the air recoils upon itself, and prevents the escape of any but a very small quantity. This action of the air in the tube is either then repeated by a series of pulsations, or it resolves itself into

two opposing currents, the downward one of which, having only slightly less velocity than the upward current, stops the passage into the annular space between the plates of any but a very minute portion of air.

In the mean time the plate C, when first struck by the air in the tube, rises, from contact with the plate B, with so great suddenness, that the air from the exterior has not time allowed to rush in between the plates and fill the vacuum; so that the pressure of the atmosphere on the top forces it immediately back to its former position, or rather till it meets with an elastic stratum of air, and combined force of the upward blast; it then rebounds as suddenly as before, and continues to repeat this action by a series of minute and almost imperceptible pulsations.

It would seem that the quantity of air escaping into the annular space by even the most forcible blast, is so extremely minute, that the plate cannot rise far before the pressure of the atmosphere on the top becomes greater than the pressure in that space and the force of the upward current on its limited area combined.

Precisely similar in all respects is the action of the safety-valve, except that its tendency to ascend on pressure being exerted below, is not retarded to the same extent as in the instrument described, by reason of its annular space bearing a much smaller proportion to the whole area of the plate. That it is, however, in some degree retarded and prevented from rising to a sufficient height for the escape of any undue quantity of steam, may be gathered from analogy, and I think this is also confirmed by experience. It would not be easy, from the data of which we are possessed, to fix the point at which a valve of given area and configuration ought to stand; but it is certain that observation points out that they never rise very high, even under the greatest pressures. Granting, however, that they do rise to a sufficient height (which they seldom or never do) so as to give an annular area for the escape of steam equal to the area of the passage leading thereto, still the effect noticed with regard to the pipe, must hold good here also; in fact, the amount of steam which the area of the passage ought to give does not escape. The fury of the steam is expended by being thrown back

in antagonism to itself, and in forming an effectual barrier to free egress, those particles which are so successful as to find a passage out making their escape into the atmosphere with a loud and disagreeable noise.

It is well known, as has been before stated, that the recoil of water in a pipe on an obstacle at right angles to its course, exercises a very great retarding influence on its flow; and it is much to be apprehended that the more elastic the fluid, the greater will be the evil.

Having thus pointed out a defect which, simple as it may appear, there is every reason to believe results in rendering the safety-valve *no safety-valve at all*, it remains to find a remedy. This is so simple and so obviously efficient that it needs no further recommendation than merely to state that it consists of making the under side of the valve of such a shape that the particles of steam on striking it shall be directed in their recoil immediately towards the opening.

Fig. 4.

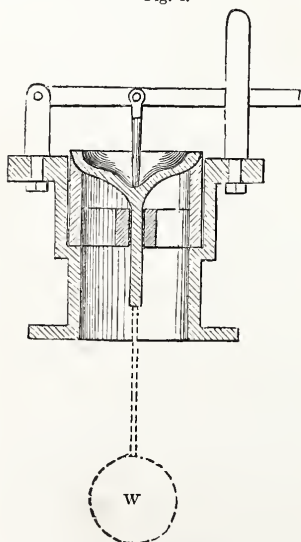


Fig. 4 will give a rough idea of such a valve; and it may be stated in confirmation of the self-evident superiority of such a construction, that pump-valves of this description which the writer has tried are, so far as may be judged from practical experiment, much more effective in their

delivery, less noisy, and better in all respects than ordinary plate-valves.

There are other minor defects in safety-valves. One of these frequently prevails in the weighted lever-valve, and is illustrated with some exaggeration in fig. 2. In consequence of the point at which the lever here bears upon the valve being placed so much above the part which guides it, and the often ill-considered position of the lever's fulcrum, it is evident that, before the valve can rise any reasonable height, a large amount of resistance must be given to its further progress, by its being forced into an angular position, thereby jamming the spindle in its guide, and adding an undue amount of friction. Some valves, it is true, being carefully constructed, and with due attention to their proper action in this respect, are not open to these objections; but it is to be feared that this applies only to the minority of cases.

The risk, however, if not entirely removed, is greatly diminished by the arrangement shown in fig. 4, where the bearing point of the lever is considerably below the seat of the valve. A weight suspended to the tail of the valve, as shown in dotted lines, might likewise be advantageously applied, in order to retain the valve in a perpendicular position, and thereby prevent it from jamming. Another imperfection may be noticed in a common application to this species of safety apparatus — namely, the ordinary spring-balance. Although this is, in other respects, a neat and convenient contrivance, it has the serious defect of giving no clue to the actual pressure in the boiler at the time when steam is blowing off. For instance, supposing the valve to have been screwed down to a given pressure, at the instant of the valve's first rising that pressure will be indicated on the scale with tolerable correctness; but on its rising and thereby lifting the lever to the smallest extent further, the spring immediately becomes stronger by tension, while inversely (from the before-mentioned causes) the tendency of the valve itself to rise becomes weaker, and that to an unknown amount.

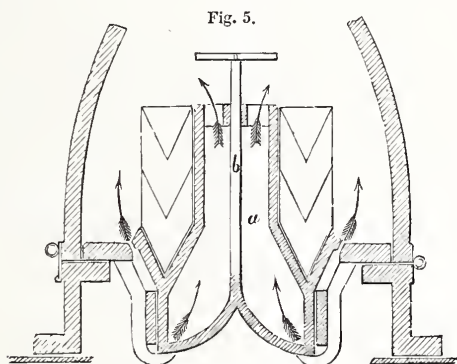
The deceptive consequences of this are obvious, and need no further explanation; but, although the matter may be made light of, as it is certain that a boiler may explode when the safety-valves are blow-

ing off* to their utmost, so is it possible that, under these circumstances, a spring-balance, instead of acting as a protector, becomes the reverse.

It is almost needless here to allude to that description of safety-valve now so generally and justly condemned by experienced engineers—namely, such as have a spindle passing through a stuffing-box, above which it is attached to the lever, the valve itself being inclosed in a chest or casing, from which the superfluous

steam is carried off through a pipe placed, generally, in a horizontal position. The absurdity of this arrangement is at once apparent; and it is much to be wondered at that so clumsy an apparatus should, to this day, be found attached to steam-boilers.

Having now endeavored to trace some of the principal causes of the imperfection of safety-valves, and being bold to assert that, in cases of real danger, they are little better than useless, as ordinarily con-



structed, I would again press the assumption that, if made on sound principles, they are capable of being rendered at once the most natural and most effectual means of protection.

Let us see, then, what are the requisites of a good safety-valve. They may, I think, be stated to be simply these: 1st, that it should be of such a form as to allow of the free egress of steam; 2d, that

it should be capable of rising by pressure any limited height freely and without sticking;* 3d, that it should be of dimensions large enough to relieve the boiler of any undue pressure of steam, even under the most unlooked-for rapidity of evolution.

The first requisite is, in some degree, fulfilled by the arrangement shown in fig. 4. The second, also, partially, although it would be better to discard the lever altogether and substitute weights, placed immediately over the axis of the

* The fact of safety-valves blowing off steam immediately before an explosion takes place, has been ascertained beyond a doubt in numerous instances. I myself was an eye-witness of one of these disastrous events, my attention and that of others being attracted to the boiler by the violent and noisy efforts of the steam to escape through the valve. This fact was distinctly sworn to at the judicial inquiry into the cause of the accident which proved fatal to the engine-tender and others near. The safety-valve was two and a quarter inches in diameter, in good working order, and the lever properly weighted. From repeated observations, I have found that in no case does a valve rise above a quarter of an inch at most, so that here was a boiler sufficiently large to supply a twenty horse-power engine with steam at sixty pounds pressure, supplied with a valve which, when open even a quarter of an inch, would present an annular area of but one and three-quarters square inches for the escape of steam. This instance will, I think, go far to prove the truth of the foregoing remarks.—H. H.

* It has been asserted that cases have been known of valves sticking in their seats through oxidation. An instance of this has been given me by an engineer of undoubted veracity, who, on examining a boiler about to undergo some repairs, discovered the valve to be so fast that a sledge-hammer had actually to be used in order to drive it from its seat; a proof, indeed, of the ignorance or utter recklessness of the attendant fireman or engineer.

It seems almost beyond belief that a brass valve can become oxidized so firmly as to resist pressure with more obstinacy than the boiler itself. It is not unlikely that, in most instances, the assertion has been invented as an excuse for some gross neglect or abuse. A properly constructed and properly weighted valve will be too frequently on the move to run the chance of rusting fast. H. H.

valve, or suspended from below ; as this, however, would be inconvenient and awkward in high-pressure boilers, and as, in order properly to fulfil the last requisite, any method of weighting would be extremely unwieldy and untractable under ordinary construction, I would submit the contrivance shown in figure 5 for consideration, as one likely to answer the purposes of a safety-valve to a fuller extent than any that has yet been in use.

It will be seen, on reference to the engraving, that this valve has two concentric bearing surfaces, so as to allow the steam to escape through the openings, as indicated by the arrows. The inner or lower opening may be made of any diameter, and the annular space between the two openings against which the pressure of the steam is exerted, may be limited to any extent, by which means the whole can be weighted in the manner shown conveniently, and without occupying much bulk.

Its advantages in this respect are great, inasmuch as an increased diameter may be used without injuring its sensitiveness or increasing its unwieldiness. Exclusive of this, moreover, it enables a much greater amount of steam to escape for a given diameter of valve, than one of ordinary construction, and none of the phenomena noticed as appertaining to the latter can here take place, providing a conical form, as shown, be given to the under side of the valve between the outer and inner seat. The contraction of the aperture at *a* will give the valve a tendency to rise more freely under great pressure by presenting an additional area to the action of the escaping steam when the valve is partially raised from its seat. The spindle *b*, which is attached to the seat, serves as a guide for the valve while the cross-piece fixed to the top prevents it from rising too high.

This form of valve may be modified and improved to some extent ; indeed, the best form must be the result of experiment ; but I would draw attention to the fact, that with this construction, or one embodying the same principles, there exists apparently no objection whatever to the employment of valves of such increased dimensions as to discharge rapidly even the most dangerous evolution of steam, or by whatever other name the

gaseous originator of pressure may be designated.

For boilers in which a very high pressure is maintained, and when weights of unwieldy bulk would be required, I would suggest the adoption of a valve, a rough idea of which may be conveyed by referring to fig. 6.

In this case I employ three concentric bearing surfaces, the inner one of which, *a*, is of much smaller diameter than either of the outer ones, *b* and *c*. It will be at once apparent that the inner bearing surface *a a*, may be so limited in diameter (the part of the valve which rests thereon, thus presenting but a small area to the pressure of steam) that but a trifling weight will be required ; indeed, the outer bearing surfaces may be so increased, the valve consequently becoming heavier, that it may be made to supply, of itself, the place of a weight, and if necessary this may be adjusted by suspending an additional weight to the tail of the spindle, as shown in dotted lines. On the rising of the valve from its seat, the steam will escape from the three openings in sufficient quantity to take off any sudden and undue pressure from the boiler.

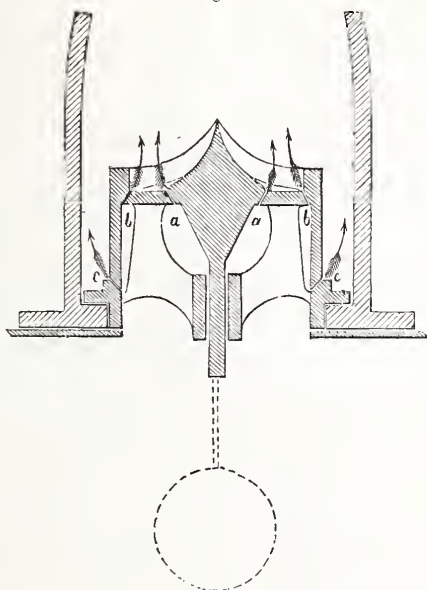
I may be allowed in conclusion to suggest a combination and application of the principles described in reference to fig. 5, constituting a safety apparatus which, however imperfect, may be confidentially stated to be superior to that commonly used in locomotive, and may be applied with advantage to all boilers. It consists of an arrangement of two valves, *A* and *B*, fig. 7, of similar construction to that shown in fig. 5. The large valve *B* is weighted by a series of metallic rings, as before described, and is of much larger diameter than the valve *A* : the latter is weighted by a combination of levers ; of these, the upper one, *D*, has its fulcrum at *E*, beyond the valve *B*, and rests on knife-edges attached to the smaller valve *A*, and is connected by means of links to the lower lever *G*, the latter being graduated and weighted in such a manner that the weight can be conveniently traversed backwards and forwards so as to indicate the pressure required. The valve *B* is also furnished with knife-edges, but reversed, and so placed that the lever *D* may bear upon them only when the valve *A* has risen a given height.

It will be understood, then, on the

pressure in the boiler becoming greater than circumstances require, the steam first escapes at the valve A, the valve B never rising till the steam becomes dangerously strong; and in order more effectually to insure the proper action of

the latter when this does take place, the valve A, rising higher under the increasing pressure, lifts the lever D till it bears on the knife edges of the valve B, and relieves it of a portion of its weight. Thus, when the attendant wishes to ascertain

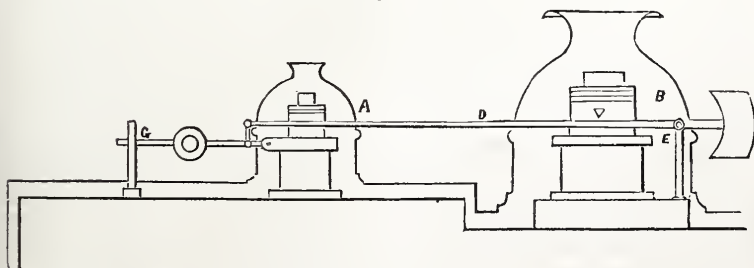
Fig. 6.



whether or no the valve B is in proper working order, all he is required to do is to move the weight back on the lever G until the valve A, rising, communicates

sufficient pressure to the knife points on the valve B, when the latter begins to move, and the escape of steam therefrom indicates that all is right. This can be

Fig. 7.



done, although the valve B should be locked up and out of the attendant's reach, while, at the same time, it cannot be af-

fected by any under weighting of the levers D and G.

For knife edges in this apparatus may,

perhaps, be advantageously substituted small steel rollers, and additional delicacy of action might be secured by counterbalancing the weight of the levers as shown.

More important improvements might be also possibly suggested, especially such as tend to simplification, which would render the above described apparatus more complete and effective. In the mean time, if it be allowed to decide a priori that the foregoing principles are correct, there seems little reason to doubt that safety-valves may be yet constructed which shall be worthy of their name.

HENRY HOWSON.

Kensington, Philadelphia, Sept. 11th, 1851.

PATENTS.

List of Patents (with claims annexed) which issued from the United States Patent Office from the 17th day of June, 1851, to the 1st of July, 1851, both inclusive.

To JOHN COOPER, of Sangamon Co., Ill. (administrator of BENJAMIN GIGER, deceased), *for Improvement in Plows*. Patented June 24, 1851.—What is claimed as the invention of Benjamin Giger, is the peculiar form and construction of the standard, with the sockets at the upper extremity and flanges at the lower, and the method of uniting them, so as to form a double machine, capable also of being used for cultivation in its separate parts, as set forth. The whole machine, as above described, constitutes Giger's Corn Planter.

To CHARLES A. POSTLEY, of Spring Garden, Pa., *for Self-acting Guard Frog*. Patented June 24, 1851.—I claim the combination of the rising and falling guards, with the levers, by means of an arrangement of levers, connecting rods, &c., to produce the results herein set forth.

To JOHN PEPPER, of Spring Garden, Pa. (assignor to CRANE, PEPPER & CRANE), *for Improvements in Knitting Machines*. Patented June 24, 1851.—I claim, first, a sinker, to be used in machines for knitting, so constructed as to form the loops upon the needles used in knitting two separate fabrics at the same time and at one operation, and of sufficient weight to draw the requisite quantity of yarn from the supply to form the loops required.

Second, a slur, to be used in knitting machines, so constructed as to let each sinker drop to the falling bar, and draw the requisite quantity of yarn from the supply, to form the loop or loops, between the needles, before it allows the succeeding sinker to drop and act upon the yarn.

Third, a falling bar, so constructed that the slurs and slur-boxes traverse upon it, instead of traversing a separate bar.

Fourth, the combination of the sinkers,

stop bars, combs, and needles that traverse, so arranged as to knit two separate fabrics at the same time, with one and the same set of sinkers and slur.

Fifth, I do not intend to limit myself to the precise construction described in the foregoing specification; but to use such forms of construction as will answer the purpose intended.

To MARIA VAUGHN, of Greenbush, N. Y. (admin. of JOSEPH C. VAUGHN, deceased), *for machinery for making wrought-iron Car Wheels*. Patented June 24, 1851.—I claim the machinery and apparatus set forth and described, to wit: the mould blocks or welders, the hammer or ram, with the wedges thereto attached, and the mandrel, in combination with each other.

To JABEZ ROBINS, of Boston, Mass. (assignor to JOEL R. MORSE, of Leominster, Mass.), *for Improvement in Machines for Splitting Horn and Shell*. Patented June 24, 1851.—I claim the cylindrical rotary bed, or drum, in combination with the water cistern, or trough, and its furnace, and machinery over the drum, for bearing the shell or material down upon it during its revolution, as specified, the said drum being provided with a roughened or frictioned curved surface, such as will adhere to the shell, and cause it to move with it and against the knife.

To HENRY MOSER, of Pittsburgh, Pa., *for Improvement in printing names of Subscribers upon Newspapers, &c.* Patented June 24, 1851.—The arrangement and construction of a machine for printing names of persons or places on newspapers and other papers, after the manner substantially as described, viz.: of a form containing the column of names to be printed set up in types, and being brought under the action of a stamp, by means of a slide moving by degrees, together with the application of a slitted plate, allowing the paper to be printed to be pressed down on the line right beneath the slit of the plate, and shielding the paper from the lines adjoining that under action of the stamp, as described.

To JACOB SELGRATH, of Pottsville, Pa., *for Improvement in Lubricating Compounds*. Patented June 24, 1851.—I claim the combination of ingredients herein described, whether the proportions be the same as herein set forth, or varied to any extent that the same may admit of, without changing the peculiar character of the compound as a lubricator.

To LAWRENCE MYERS, of Philadelphia, Pa., *for Improvement in Cars for Transportation of Coal*. Patented June 24, 1851.—I claim the combination of a partition or partitions, with a metallic cylinder or cylinders, provided with flanged rims, as herein described, for the purpose of carrying material in bulk, on rail or other roads where high velocities are attained, said material being held in place by centrifugal force, whilst in motion, and prevented from falling or rolling in the cylinder, by the partition or partitions, whilst in the act of stopping or starting, or by any other means essentially the same.

To SYLVANUS SAWYER, of Templeton, Mass.,

for Improvement in Machinery for Cutting Rattan, &c. Patented June 24, 1851.—I claim, first, the combination of the cutters, as described, with the levers, the springs, and cams, or their equivalents, and handles and links, for the purpose of applying said cutters or scrapers, so as to act upon the stick of rattan in the manner herein described, and by which they may all be operated simultaneously.

Second, in the process of cutting cane or rattan into strands, as described, I claim bending the stick at the point at which the cutter is removing the strand from the surface.

Third, I claim the combination of the elements which compose each simple section of the cutting apparatus, that is to say, of the cutter and gage, with the stock, guide, and bed-roller, or their equivalents, substantially as described, for the purpose of bending the stick and removing the strand therefrom, whether the said section is used alone or is combined with others.

Fourth, I claim the combination of that part of the machine called the scraper, with the feeding rollers or their equivalents, and the several sections of the cutting apparatus, said sections being so arranged, in relation to each other, as that the stick, in passing from one to the other, shall be properly bent, and also that the several cutters should act upon different points of its circumference, the whole being arranged and operating as set forth.

To CHARLES STARR, of New York, N. Y., *for Improvement in Machines for finishing the Backs of Books.* Patented June 24, 1851.—I claim, first, the use, for the purpose described, of a roller of the whole length or part of the length of the back of the book, either plain for a plain back book, or grooved for a raised banded book; or having a figure or figures cut or engraved, or otherwise made upon it, rolling over the back of the book, from side to side, or from the centre to the sides, and having a yielding pressure applied to it by weighted levers, or their equivalents, in the manner described.

Second, I claim clamping or holding the book in a swinging book-holder, or its equivalent, which hangs on pivots or journals, and is capable of being swung back and forth, so as to cause the back of the book held in it to describe an arc of a circle, and bring each part of the back to the roller, so that it shall receive an equal pressure all over its surface, for the purpose as set forth.

Third, the gages sliding upon an inclined bar, or bars, that they may be set to form guides for placing both ends of the back of the book at an equal or nearly equal elevation in the clamp, so as to cause each part to receive a uniform pressure, and may be drawn back from the book without dragging or rubbing the surface of the back, in the manner shown.

To SAMUEL T. ARMSTRONG, of New York, N. Y., *for Improvement in making Gutta Percha Hollow Ware.* Patented June 24, 1851.—I claim the method, as described, of moulding articles of gutta percha, or the compounds of gutta percha, with other substances, by first

making the same in the form of a pipe, and whilst in a partially heated and plastic state, giving to it the form required in a mould by forcing a liquid inside to expand the gutta percha.

To WM. & WM. H. LEWIS, of New York, N. Y., *for Improvement in fastening Pedestals to Columns.* Patented June 24, 1851.—I claim the application of the piece, C, and different shaped lugs, 8 and 9, on the end of the column, to enter the hole 2, and notches 3 and 4, so that on turning the columns the lugs take the inclined seats, to attach the column to the pedestal, in combination with the locking piece, to prevent the column turning, as described.

To WM. H. START, of Smyrna, Del., *for Improvement in Grain Harresters.* Patented June 24, 1851.—I claim, first, the standard to which the steering wheel is attached, constructed as herein described, so as to perform its own office proper, and also to adjust the cutter at the required height above the surface of the ground.

Second, the discharging rake, which is moved as described, in combination with the endless apron for collecting and discharging the cut grain, as set forth.

To JOSEPH WRIGHT, of Waterloo, N. Y., *for Improvement in Mashing Tubs.* Patented June 24, 1851.—I claim, first, the employment of buckets formed by the revolving arms, working within the hopper, for delivering the grain through suitable openings into, and operating in combination with the mashing cylinder, having an outlet or outlets for supplying the cooler, as described.

Second, the use of a mashing cylinder, having beaters within it, and operating in combination with a cooler, carrying any number of barrels or shafts fitted with projecting pins, essentially as described for the purposes as set forth.

To JEAN BLANC, of New Orleans, La., *for Improvement in making Hemp from Okra.* Patented June 24, 1851.—I claim preparing of hemp from the bark of the okra plant, in its green state, and the herein described method of preparing it for use.

To WILLIAM HINES, of Otsego, N. Y., *for Vice Saw Set.* Patented July 1, 1851.—I claim constructing a vice for the purpose of compressing saws to be set or filed, in the following manner, namely, with only one supporting arm to each jaw, hinged at their lower extremities, and having an extra arm on one side of and parallel, or nearly so, to said supporting arms, to the upper extremity of which is attached an eccentric lever, or its mechanical equivalent, for compressing the two jaws together.

To WASHBURN RACE, of Seneca Falls, N. Y., *for arrangement of catches on the upper sash, operated by moving the lower sash.* Patented July 1, 1851.—I claim the arrangement herein described, of the catches and window sashes, for the purpose described.

To BENJAMIN KRAFT, of Reading, Pa., *for Improvement in Boxes and Axles for saving oil.* Patented July 1, 1851.—I claim causing the

bevelled edges of the oil-box to enter the grooves of the axle and rest against their outer shoulders but not against their inner ones, thus at the same time preventing end play and the escape of the oil—the journal bearing being lower than the bevelled edges of the oil-box, and sufficiently above the bottom of it, to prevent oil coming from the box of the journal.

To HENRY WHITNEY, Jr., of Cambridge, Mass., for *Improvement in Inkstands*. Patented July, 1, 1851.—I claim my inkstand as a new article of manufacture, in which the following features are, for the first time, associated, viz.: an elastic diaphragm covered and secured from injury, by a metallic cap, regulated by a screw passing through the cap, and in combination with the diaphragm, the funnel stop, and waste cup.

List of English Patents from July 3, 1851, to July 22, 1851, inclusive.

John Platt, of Oldham, Lancaster, engineer, and Richard Burch, of Heywood, Lancaster, manager, for certain improvements in looms for weaving, July 3; six months.

James Howard, of the Britannia Iron Works, Bedford, agricultural implement maker, for improvements in ploughs, and other implements or machines used in the cultivation of the soil. July 3; six months.

John Aston, of Birmingham, manufacturer, for improvements in buttons and ornaments for dress, and the machinery for making the same respectively. (A communication.) July 3; six months.

Charles Payne, of Wandsworth-road, Surrey, gent., for improvements in drying animal and vegetable substances, and in heating and cooling liquids. July 3; six months.

Robert Haynes Easum, of Commercial-road, Stepney, Middlesex, rope-maker, for improvements in the manufacture of rope. July 3; six months.

William Hamer, of Manchester, for certain improvements in looms for weaving. July 3; six months.

George Kemp, of Carnarvon, North Wales, doctor of medicine, for a new method of obtaining power by means of electro-magnetism. July 3; six months.

Richard Jex Crickmer and Frederick William Crickmer, of Page's walk, Bermondsey, engineers and co-partners, for improvements in packing stuffing-boxes and pistons. July 3; six months.

Charles Cowper, of Southampton-buildings, Chancery-lane, Middlesex, patent agent, for improvements in the preparation of cotton for dyeing and bleaching. July 3; six months.

Charles Barlow, Esq., of Chancery-lane, London, for improvements in rotary engines. (A communication.) July 3; six months.

James Hamilton, of London, engineer, for improvements in machinery for sawing, boring, and shaping wood. May 22.

Adolphus Oliver Harris, of High Holborn, Middlesex, philosophical instrument-maker, for improvements in barometers. June 10.

William Becket Johnson, of Manchester, manager for Messrs. Ormerod and Son, engineers, for certain improvements in steam engines, and in apparatus for generating steam; such improvements in engines being wholly or in part applicable where other vapor and gases are used as the motive power. June 10.

Frederick Rosenborg, of the Albany, Middlesex, Esq., for improvements in the manufacture of casks,

barrels, and other like articles, and the machinery employed therein. July 5; six months.

Henry Craven Baildon, of Edinburgh, chemist, for improvements in writing, printing, or marking letters, characters, or figures upon paper, parchment, or other materials properly prepared for that purpose. July 7; six months.

James Buchanan Mirlles, of Glasgow, Lanark, North Britain, engineer, for certain improvements in machinery, apparatus, or means for the manufacture or production of sugar. July 7; six months.

John Hick, of Bolton-le-Moore, Lancaster, engineer, for certain improvements in steam boilers or generators. July 17; six months.

William Dickinson, of Blackburn, Lancaster, machine-maker, and Robert Willan, of the same place, mechanic, for certain improvements in machinery or apparatus for manufacturing textile fabrics. July 17; six months.

Thomas Wilks Lord, of Leeds, York, flax and tow machine maker, and George Wilson, director of the flax-works of John Fergus, Esq., M. P., of Preulaws, Fife, North Britain, for a machine to open and clean tow, and tow waste from flax and hemp and other similar fibrous substances, and an improved mode of piecing straps and belts for driving machinery, and a machine for effecting the same. (A communication.) July 17; six months.

John M-Nab, of Midtownfield, Renfrew, North Britain, for certain improvements in stretching and drying textile fabrics or materials, and in the machinery or apparatus employed therein. July 17; six months.

Arthur Albright, of Birmingham, manufacturing chemist, for improvements in the manufacture of phosphorus, and in the apparatus to be used therein. (Being a communication.) July 17; six months.

Thomas Sanders Bale, of Caudon-place, Stafford, china manufacturer, for certain improvements in the method of treating, ornamenting, and preserving buildings and edifices, which said improvements are also applicable to other similar purposes. July 17; six months.

Arthur Field, of Lambeth, gentleman, for improvements in the manufacture of candles, night-lights, and mortars. July 22; six months.

Samuel Varley, of Sheffield, engineer, for improvements in relating and stopping railway carriages, and in making communications between the guards and engine-drivers on railways. July 22; six months.

Thomas, Earl of Dundonald, admiral in Her Majesty's Navy, of Chesterfield-street, Middlesex, for improvements in the construction and manufacture of sewers, drains, water-ways, pipes, reservoirs, and receptacles for liquids or solids, and for the making of columns, pillars, capitals, pedestals, vases, and other useful and ornamental objects from a substance never heretofore employed for such manufactures. July 22; six months.

Thomas Marsden, of Salford, for improvements in machinery for hackling and combing flax, and other fibrous materials. July 2.

William Melville, of Roebank-works, Lochwinnoch, Renfrew, North Britain, calico printer, for certain improvements in manufacturing and printing carpets and other fabrics. July 10.

NOTICES AND CORRESPONDENCE.

WE regret to say that the numbers of the American Artisan do not appear as regularly on our table as we could wish; we having reason to regard it as a valuable auxiliary, and fear that we have unconsciously lost some good things. An unknown friend (who will accept our acknowledgments for his thoughtfulness) has sent us the Number issued

on the 6th of September, and among other good matters, we see some quotations from our August number, in reference to Sawyer and Gwinne's new motive power, with comments by H. L. Stuart.

As Mr. Stuart's censure goes no further than to charge us with "ignorance and indiscretion," we can put up with it; but when intending to commend us, we are made (according to his statement) to "back out gracefully," we must beg leave to respond, so far at least as to assure him, that as we have already, so we shall continue, to aim rather at his censure than his praise.

Such of our readers as may see in our comments on Mr. Sawyer's article, in the September Number of the Magazine, any retraction of our opinion given on this same subject in the August Number, possess most undeniably an "uncommon" microscopic vision; and such of them as see a "gross ignorance" in the use of the term *centrifugal*, as applied to motion from a centre, we shall be excused from considering in the light of teachers. We can do no better, in relation to this matter, than to lay before our readers Professor Loomis' article, contributed to the New York Tribune, which may be considered as settling the value of the "newly discovered law of nature."

Sawyer and Co.'s Perpetual Motion.—Several months since, when consulted with reference to the principles of a new machine, called the "Static Pressure Rotary Engine," I gave the opinion that the machine would not work. Several weeks afterwards I was challenged by Mr. Andrews, through the columns of The Tribune, to give my objections to this machine. This challenge I did not see fit to accept, supposing that the public generally felt very little interest in the matter. As, however, you have expressed a desire to know "why the thing won't go," I will give you a reason which I trust will appear satisfactory.

Mr. Sawyer's machine consists of a covered cylindrical basin, 26 inches in diameter and two inches deep, to which is attached a vertical tube four inches in diameter and of any required length. A spiral groove runs the whole length of the tube, and this, together with the basin, is supposed to be filled with quicksilver. The whole is to be rapidly revolved about a vertical axis, when the centrifugal force of the mercury in the basin drives the mercury out through a valve on the edge of the basin, and leaves a vacuum behind. The mercury, as it escapes from the basin, falls into a reservoir communicating with the bottom of the spiral groove, through which it is forced by the pressure of the atmosphere with such velocity that the reaction of the sides of the groove causes the tube and the attached basin to revolve with great momentum, evolving a new centrifugal force by which the vacuum is perpetuated. Mr. Sawyer supposes that the centrifugal force of the revolving mercury is sufficient to maintain its own revolution unimpaired, and leave a large surplus capable of being applied to any useful purpose.

This conclusion is founded upon the computations of Prof. Bull. Prof. Bull has computed that a wheel 16 inches in diameter, and weighing 531 pounds, revolving 25 times in 10 seconds, will have a centrifugal force of 2716 pounds; and that this velocity may be produced by a power of 166 pounds applied $1\frac{1}{2}$ inches from the centre, or a power of 452 pounds acting on the spiral groove already mentioned. Hence, says Mr. Sawyer, we have "a clear surplus of 2264 pounds more than is required to turn the wheel." If this were so, it would constitute the most beautiful perpetual motion ever dreamed of by the visionary. But, unfortunately, Mr. Sawyer has

committed a grave mistake, in supposing that 452 is the proper measure of the force required to turn the wheel. The productive effect of a motive force is usually measured by the product of the force into its velocity. Mr. Stuart appears to have perceived the above mistake, and in The Tribune of Sept. 6, has given the following corrected results applicable to the preceding data.

	Velocity in feet per second.	Power expended.	Centrifugal force.
1.....	10	5,310	2,716
2.....	20	10,620	10,864
3.....	40	21,240	43,456
4.....	80	42,480	173,824
5.....	160	84,960	695,296

The preceding numbers indicate that Mr. Stuart is approaching to more rational views with regard to the action of the new machine. I understand Mr. Stuart now to concede, that to produce a centrifugal force of 2716 pounds, requires an expenditure of 5310 pounds. Velocity No. 1, therefore, will not answer Mr. Sawyer's purpose. To produce a centrifugal force of 10,864 requires an expenditure of 10,620. But we must allow for some loss by friction, therefore velocity No. 2 is insufficient. A centrifugal force of 43,456 requires an expenditure of 21,240. Now, this is the power required to be exerted directly on the circumference of the wheel in order to evolve the given amount of centrifugal force. But Mr. Sawyer proposes to apply the pressure upon a spiral groove, in consequence of which, according to the computations of Prof. Bull, the required power must be increased nearly three-fold, making it 60,000. Velocity No. 3, therefore, is insufficient. Let us then examine velocity No. 4. This velocity corresponds to twenty revolutions of the wheel per second. Now the wheel of a railroad car, 32 inches in diameter, and making twenty revolutions per second, would travel at a rate exceeding one hundred miles per hour. It will readily be perceived that we are getting into the neighborhood of velocities which are somewhat formidable.

We must now attend to another consideration. The mercury was supposed to be forced up the tube by the pressure of the atmosphere. But the pressure of the atmosphere is only equal to fifteen pounds per square inch; and the amount of surface upon which this pressure is available (the end of the tube) is only ten inches, so that the entire available pressure of the atmosphere only amounts to 150 pounds. The enormous centrifugal force developed by the rotation of the mercury must, therefore, remain almost wholly unavailable, unless we can create a corresponding artificial pressure. This Mr. Sawyer proposes to do; and inasmuch as with a centrifugal force of 2716 pounds, he requires the same amount of pressure on ten inches of surface, he proposes to surround the apparatus by a close chamber, and pump in air until the pressure on the surface of the quicksilver amounts to 271 pounds to the inch. Some of the high-pressure boats on the Western waters carry steam of 180 pounds pressure, which frequently results in explosions. Mr. Sawyer appears to apprehend no danger from 270 pounds. But we have already seen that a centrifugal force of 2761 pounds is not equal to the power required to keep the machine up to the corresponding velocity, and that the same was true of velocities Nos. 2 and 3, and we proposed to examine velocity No. 4, corresponding to a centrifugal force of 173,824 pounds. Now to make this entire force available, Mr. Sawyer (according to the reasoning just stated) must pump air into the air chamber, until the pressure on the surface of the quicksilver is 17,382 pounds to the inch! If the boilers of Western steamboats explode with a pressure of 180 pounds to the inch, where will Mr. Sawyer find a vessel which will withstand 17,000 pounds to the inch?

I trust I have succeeded in showing that, according to their own data, the project of Sawyer and Co.

is perfectly visionary. The preceding objection may be summed up as follows: According to Sawyer and Co.'s own data, the *centrifugal force of a revolving wheel exceeds the power required to produce the rotation only at exceedingly high velocities—and in order to avail themselves of the full extent of this centrifugal force, they must employ air of such density that no vessel could possibly resist its pressure.*

ELIAS LOOMIS.

New York University, Sept. 8, 1851.

We add the concluding paragraph of the Professor's rejoinder to the article from Mr. Sawyer published in answer to the above:

In conclusion, if there are any who believe that Mr. Sawyer's project for a perpetual motion will succeed, I would urge them to show their faith by their works, and contribute the requisite means to test the principle by actual experiments—and if it should be found that the machine operates in the manner claimed by Mr. Sawyer, then I will not merely consent to be called "green," but will engage to take stock in the "Static Pressure Rotary Engine Company."

ELIAS LOOMIS.

New York University, Sept. 20, 1851.

NEW HAVEN, Aug. 30th, 1851.

MR. EDITOR:—In your first number of the *Mechanics' Magazine and Engineers' Journal*, you invited correspondence with the operative as well as theorist, and in accordance with that invitation, I write you, to correct an error on the part of Mr. Fairbairn's application for a patent on certain processes in moulding the parts of work for his machine connected with flax cotton spinning. I allude to his claim of placing parts of the pattern on opposite sides of a board, and forming the sand-mould on each side, and then removing the board which holds half of the pattern on each side; then closing the flask which comes directly to its first position by means of the steady pins. This process, if I understand aright, Mr. Fairbairn claims as original. Unfortunately for him, I can assure you, that this process, and also that of using "green sand cores," which he also claims, has been in constant use in Connecticut for a long time, so that no patent can be sustained by him, if obtained from the Patent Office.

With us this method is termed "match-moulding," and I think it is, for the most part, confined to this State, although other sections may be in possession of the same knowledge. We also employ another process for small work, known as "snap flask moulding," which greatly facilitates the speed of moulding, as the workman makes use of but one flask for the same or nearly the same size pieces for each day's work. By this means the flask is *unhooked* at one corner, and turning on a hinge at the opposite angle, is readily taken off from the sand, and again used repeatedly in the course of other moulds.

Thinking that the readers of your valuable journal would like to know of the facts in this case, as in all others concerning "patent claims," I have ventured to trouble you with this brief statement.

F. R. H.

We perceive in a late number of the *Glasgow Practical Mechanic* a complaint, that in the fourth number of our *Magazine* (the only one which had come to hand) a very liberal proportion of the matter had been taken from that journal, and without acknowledgment. Upon examination, we find but a few articles unacknowledged; and whenever this is the case, it has arisen entirely through inadvertency, as a further examination of the work would have shown.

We regret having been guilty of this double injustice—to our readers for not copying more freely from the *Practical Mechanic* than we have done—and to our valued cotemporary for not acknowledging the little we have borrowed from him.

We send him the first number of our *Magazine*, in the Introduction to which he will find an evidence of the respect in which we hold his *Journal*; which should be a sufficient guarantee that we do not aim at success through petty larcenies on him.

To the Editor of *Appletons' Mechanics' Dictionary*.

SIR:—Being a constant reader of your very valuable periodical, the *Dictionary of Mechanics, Engine-Work, and Engineering*, I am emboldened to ask you for information upon a subject which will, at least, be interesting and instructive to one of your subscribers. It is this: How is a church (musical) organ constructed?

Please explain as fully as possible, the construction of the several tubes, together with the phenomena of their producing sound. I have the honor to be,

Sir, your obedient servant,
J. C. C.

We regret that our labors on the *Dictionary* had terminated before the receipt of the above; the matter for its completion having been then for some time in the hands of the printer. However, we will endeavor to find an opportunity for answering the query, although, with friend Burton, we are constrained to confess "that we fear 'tis not in our way."

The machine represented in our last, on page 533, as Kenworthy's Power Loom, should have been named "Kenworthy's Improved Dressing and Sizing Machine."

If any thing were wanting to add conviction to the impression which we already entertain, that the *Fire Annihilator* of Phillips is a precious piece of bum-buggery, it is furnished by the advertisements of their agent and manager, P. T. Barnum. That the manager of Joice Heth, and artificial mummies, and fossil remains, and manufactured natural curiosities without number, should have been selected to puff the *Annihilator* into public notice, we regard as evidence that its owners trust less to the intrinsic merits of their machines, than to the world-renowned merits of their manager; who has pulled more wool over the eyes of the public than any other manager extant. We have but space to record our opinion of the practical merits of this machine. Among the localities specified in the advertisements of the manager as having patronized the machines, the "Crystal Palace" is mentioned: such of our readers as dwell in iron houses as the Crystal Palace, may trust to the *Fire Annihilator*; others may, if they choose, purchase them; but common prudence would suggest that their action at a "real fire" be first witnessed before placing entire reliance upon them. One thing is certain; that if they will extinguish fire, the vapor *cannot* be breathed with impunity, as is alleged it may be the manager; and precisely in the proportion that the vapor is harmless to life, is its inefficiency to extinguish fire to be estimated.

SHERWOOD'S IMPROVEMENTS IN NAIL-CUTTING MACHINERY.

Fig. 3.

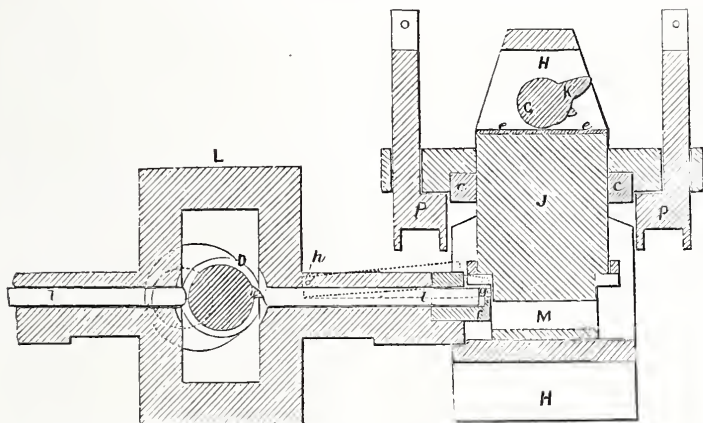
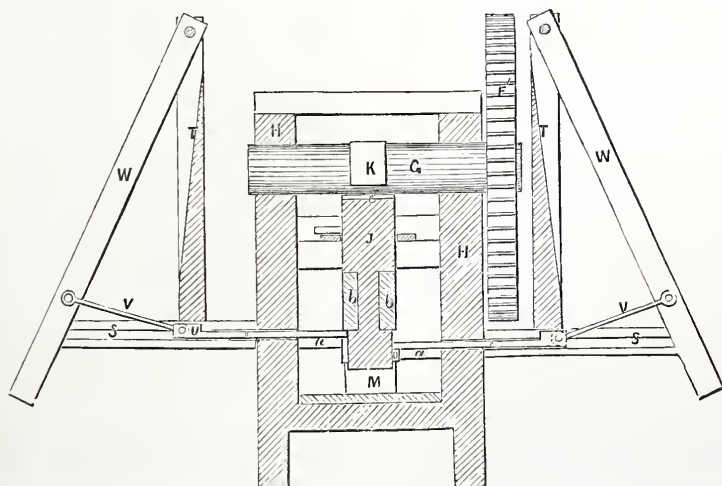


Fig. 5.



SHERWOOD'S IMPROVEMENTS IN NAIL-CUTTING MACHINERY.

From the Specification of the Inventor, John P. Sherwood, of Fort Edward, State of New York. Patent dated August 26, 1851.

FIG. 1 represents a side elevation of my cut-nail machine; fig. 2 is a plan of the same; fig. 3 is a vertical longitudinal section; and fig. 4 is a plan of a fragmentary portion of the machine; fig. 5 is a vertical transverse section through one of the knife-stocks; fig. 6 is a face view of one of the knife-stocks; and fig. 7 is an end view of one of the gripping tongs and the parts connected therewith.

My cut-nail machine is constructed to cut, gripe, head, and deliver nails automatically.

The object of the first part of my invention is to dispense with the necessity of turning the cut-nail blank one-quarter of a revolution before submitting it to the gripping dies, and it consists of reciprocating gripping tongs which open and close in a direction perpendicular to the face of the nail-plate and which advance upon the nail-blank, gripe it and draw it endwise from the position in which it is placed by the action of the knives.

The object of the second part of my invention is to equalize the strain upon a machine in which several nail-blanks are cut by one stroke of the same knife-stock, and it consists in arranging the knives and operating the knife-stock in such manner that the nail-blanks are cut in succession as the moving knives approach the stationary ones. The third part of my invention relates to the relative movements and positions of the gripping dies and heading tool, and it consists in arranging the latter to move within a pair of jaws which constitute the gripping dies, the whole being so arranged that the nail-blank is headed irrespective of the movement of the gripping dies.

And the last part of my invention consists of a double-acting reciprocating gripping and heading carriage, furnished at each of its extremities with sets of gripping and heading apparatus which act alternately and in connection with two sets of severing knives, whereby much time is saved, as a nail is formed at each single stroke of the gripping and heading carriage. The several acting members of my machine, as represented in the accompanying drawing, are all secured to a strong bed-frame A, to the lower side of

which two pillow-blocks B are secured to support the driving-shaft C, to which power is imparted either through the intervention of a belt and belt-pulleys, or by means of some other convenient and suitable mechanical device. Pairs of pillow-block standards B' B' B' are erected upon the opposite sides of the bed-plate to support the journals of three transverse crank-shafts D D' D', one of which is immediately above the driving-shaft C, and the other two are situated at equal distances on each side thereof. The central crank-shaft D is put in motion by the driving-shaft, through the intervention of a toothed pinion E, and wheel F, secured to the respective shafts; the lateral crank-shafts D' D' are caused to revolve simultaneously with the central one D, and in the same direction by means of three equal cog-wheels E' E' E', secured to the respective shafts D D' D', and of two intermediate wheels F' F', which are of half the diameter of those on the crank-shafts, and are secured to two intermediate shafts G G, whose journals are supported in suitable boxes secured to two frames H H. These frames are firmly secured to the bed-frame at points intermediate between the crank-shafts; they support the cutting apparatus by means of which the nail-blanks are severed from the nail-plates while the crank-shafts give motion to the carriages which carry the gripping and heading apparatus. The cutting apparatus connected with each cutter-frame H is composed of four stationary and four moving knives. The former, a a, are arranged in pairs upon opposite sides of a socket M, which guides the lower extremity of a reciprocating knife-stock J, to which the four moving knives b b are secured. The upper extremity of the knife-stock is guided by the blocks c c, which are secured to the standards of the frame, and it is fitted with springs, which tend to hold it to its highest position. This knife-stock is depressed at the proper moment to cut the nail-blanks by means of a double-graded cam K, which is secured to the shaft and acts upon a shoe e, secured to the upper extremity of the knife-stock. It is raised whenever the cam in its rotation passes

Fig. 1.

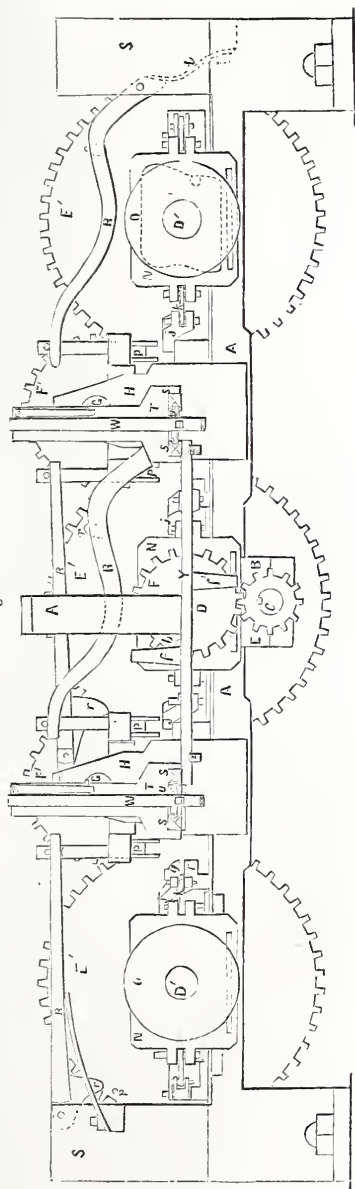
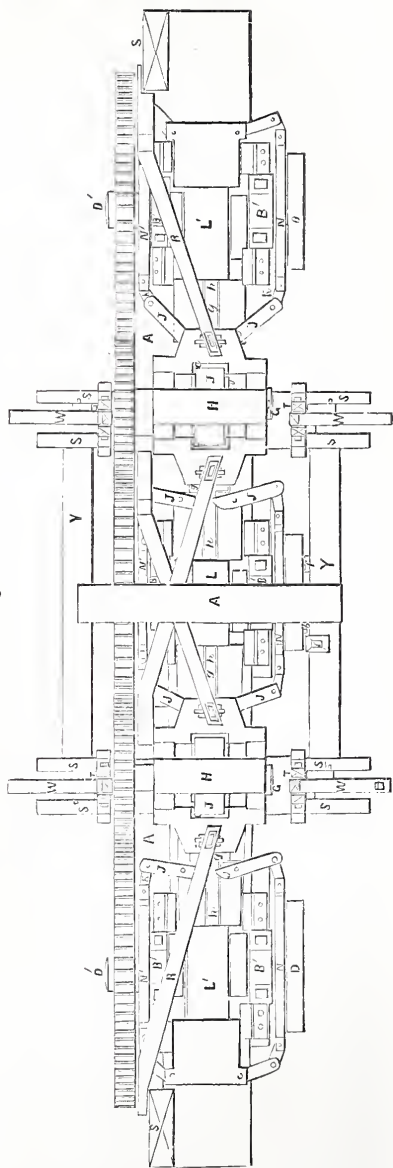


Fig 2.



the shoe *e*, by means of two springs which are projected in opposite directions from the cross-bars of the cutter-frame *h*.

The stationary knives of each pair are

bevelled in opposite directions, as shown at fig. 4, and the corresponding pair of movable knives are also bevelled, as shown at fig. 6. The pair of stationary knives

upon one side of the machine are placed a little below the opposite pair, so that the movable knives corresponding with the former shall not act until the movable knives corresponding with the latter have finished their work. The lower extremity of the knife-stock, or that portion of it which extends below the movable knives and works in the socket of the bed-frame, is bevelled in a direction the reverse of that of the stationary knives, and is situated at such a distance from their edges that the space included between each of the latter and the adjacent face of the knife-stock when the latter is at its highest position, has the same breadth and taper as that of the nail-blank to be cut.

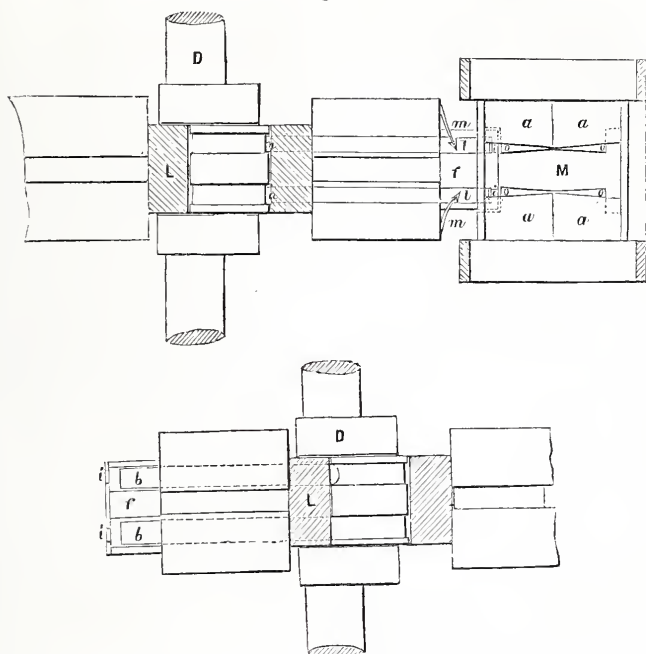
The upper edges of the socket in which the lower extremity of the knife-stock works, form rests *o o*, upon which the nail-blanks, severed by the knives, are delivered by the downward movement of the knife-stock, and from which they are drawn endwise by the action of the reciprocating gripping and heading apparatus. Each cutter-frame has two double sets of gripping and heading apparatus appertaining to it, one of which is moved to and fro at each of its sides. In the present machine there are two cutter-frames and four sets of gripping and heading apparatus; the two sets which are situated between the adjacent sides of the cutter-frames are attached to the same carriage *L*, which is arranged to slide upon ways secured to the bed-frame of the machine, and is moved to and fro between the two cutter-frames by the crank-wrist of the central crank-shaft *D*, which passes through and works in a rectangular socket formed in the middle of the carriage. The sets of gripping and heading apparatus, which are situated at the outer sides of the cutter-frames, are attached to separate carriage *L' L'*, which are also arranged to slide upon ways like those of the central one, and are moved towards and from the sides of their respective cutter-frames by the crank-wrists of the outer two crank-shafts *D'* and *D'*, which work in rectangular sockets formed at the middles of their respective carriages.

Each double set of gripping and heading apparatus consists of a pair of gripping jaws and two heading punches; the gripping jaws or tongs consist of two jaws

f and *g*, the lower *f* of which is fixed to the carriage, while the upper terminates in a shank *h*, which is pivoted to the carriage, and is situated in a socket formed therein by means of which it is guided in opening and closing. The pivot of the upper jaw is horizontal, so that this jaw rises from the lower in opening and is depressed towards it in closing; the upper jaw is pressed away from the lower by a spring, which acts upon the under side of its shank and tends to keep it raised. The upper jaw is depressed upon the lower by means of a pair of bevel-ended levers *j j*, which are pivoted to the carriage, and whose hinder extremities are connected by link-bars *k k*, with sliding frames *n* and *n'* situated at opposite sides of their respective carriages. Each of these frames is slotted near its lower edge to traverse upon guide-pins secured to the bed-frame, and each is carried along with the carriage in its movement until the proper moment arrives for gripping the nail-blanks, at which time the frames are moved independently of their respective carriages by pins, which, at one side of the machine, are secured to, and revolve with the adjacent faces of the crank-shaft cog-wheels, and at the other side of the machine are secured to the inner faces of the wheel *F*, upon the central crank-shaft, and circular disks *o o*, upon the outer ones. The pins appertaining to the opposite sliding frames are exactly opposite each other, so that the opposite frames are moved simultaneously, and the interior peripheries of the frames are of such form that the pins act to move them when the carriage has arrived at the end of its stroke in either direction. The movement of the frames moves the levers *j j*, the pair at one extremity of the carriage being moved to depress their respective gripping jaw, while those at the other are simultaneously moved to allow theirs to open under the action of its spring. The pin is in such a position with respect to the respective crank-shaft that the movable gripping jaw at that extremity of the carriage which is nearest its respective cutter-frame is depressed while the other is allowed to rise.

The adjacent faces of each pair of gripping jaws have two curved grooves *i i* formed in them, which correspond with each other, and are placed in such posi-

Fig. 4.



tions with respect to the rests *o o*, upon which the nail-blanks are delivered, that a straight line drawn through the centre of the latter passes through the centre of the grooves. These grooves are of such depth that when the upper gripping jaw is closed upon the lower, the elliptical or oval space included between the two grooves is equal in depth with the thickness to which it is necessary to reduce a nail-blank by gripping in order to hold it firmly during the action of the heading tool. The extremity of each pair of gripping tongs is at such a distance from the crank-shaft of its carriage that when the latter is moved towards the cutting-knives the jaws of the tongs will enter the cutter-frame a sufficient distance, as shown in fig. 3, to gripe the nail-blank lying on the rest *o*, at the proper distance from its head; and in order to permit the entrance of the gripping tongs, the outer extremities of the rests and the corresponding portions of the lower extremity of the knife-stock are cut away.

The heading tools are arranged to work within the gripping tongs: there is

one for each pair of knives; each consists of a sliding-bolt *l*, which slides longitudinally in a socket formed in the carriage; they are forced outwards by means of cams *n*, secured to crank-wrists, and are returned inwards when these cams, by the revolution of the crank, pass their inner extremities by means of springs *m*, secured to the carriage.

The discharging apparatus consists of wedge-formed plungers or pistons *p*, one of which is constructed to slide vertically in guides on each side of each cutter-frame. These pistons are placed in such positions with respect to the gripping tongs beneath them, that when the latter are at their furthest distance from the cutter-frames, the pistons, in descending, will clear the extremities of the gripping tongs. The breadths of the lower extremity of a discharging piston is a little less than the distance between the two sets of curved recesses in which the nail-blanks are gripped, so that it can enter between them as it is depressed, and can shove them laterally from the jaws of the gripping tongs. Each discharger is ope-

rated by a separate lever *R*, which is pivoted at its heel to the standard of the opposite cutter-frame, or to a supplementary standard *s*, erected upon the bed-frame. Each is depressed at the proper moment to discharge the nails by means of a pin *p*, which is secured to the adjacent face of the crank-shaft cog-wheel, and which acts upon a snug *r*, projected from the lever near its heel. Each lever is raised to lift its discharger after the pin has ceased to act, by means of a spring *t*, which maintains the discharger in a raised position until the pin again begins to act. As the cog-wheels to which the pins are secured all revolve in the same direction, while the levers project in different directions, some of the snugs on which the pins act are projected above the pivots of their levers, while others are projected below, as shown in the drawings. As one of these levers also crosses another, it is necessary to bend one or both to prevent them from coming in contact with each other. The snugs of the two central levers must also

be grooved or otherwise constructed to permit the pin which works each lever to revolve without affecting the snug of the other lever.

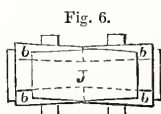
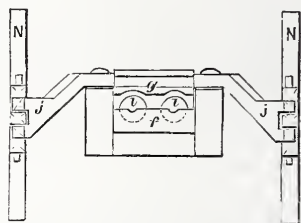


Fig. 6.

In order to feed nail-plates to this machine, a travelling feeding carriage is applied to it. This carriage consists mainly of four spring feeders, one for each extremity of each cutter-frame, which are connected by suitable framework. Each feeder is composed of a pair of grooved guides *s s*, in which the nail-plate is inserted, and which are firmly secured to a standard *T*, together with a driver *U*, by means of which the nail-plate in the guide-grooves is forced endwise through an aperture in the adjacent standard of the cutter-frame, and thence over the stationary knives to the proper position for cutting. The driver is fitted to slide in the grooves of the guides, and is connected by a link-rod *v* with a bar *w*, which is pivoted at its upper extremity to the upper end of the standard *T*, and is drawn towards the latter by a spring *x*; the latter, acting through the bar and link-rod, forces the driver inwards or towards the knives. The two feeders at each side of the ma-

chine are connected by side pieces *yy*, which are supported by rests *z*, upon which they are constructed to slide longitudinally, so as to place each feeder in proper positions to feed the nail-plate alternately to each adjacent pair of knives. The side pieces of the feed carriage are connected by an upright frame *A*, which passes over the intermediate portions of the machine; and the carriage is moved to and fro at the proper intervals by means of a pin *b*, which is secured to the face of the cog-wheel *F*, and in its revolution acts in alternate succession upon two standards *f* and *f'*, one of which is projected above, and the other below the horizontal line, passing through the axis of the central crank-shaft, to which the cog-wheel *F* is secured.

Fig. 7.



When the machine is in operation the nail-plates to be cut are applied endwise to the four feeders by an attendant, who draws the driver outwards by hand, inserts the plate, and then allows the driver to bear against its outer end. As the nail-plate is forced inwards by the driver, it is projected over the stationary knife, with which the feeder is acting at the time, and against the face of the moving knife on the knife-stock; as the edge of the moving knife rises by the upward movement of the knife-stock the extremity of the nail-plate is driven beneath it, and strikes the face of the lower portion of the knife-stock, which thus acts as a gage to limit the breadth of the nail-blank. The plate remains in this position until the knife-stock is depressed by the action of the cam above; by this depression the moving knife is forced down upon the nail-plate, and severs that portion of it which projects over the edge of the stationary knife from the remainder. As the knife-stock continues to descend it forces the nail-blanks thus

severed by the knives upon its opposite sides downwards, and delivers them upon the rests beneath. The knife-stock is then raised by the springs, which act as soon as the cam has passed the shoe at the upper extremity of the knife-stock. As the knife-stock rises, the gripping tongs advance with their jaws open, and embrace the extremities of the nail-blanks laying upon the rests. As soon as the jaws have passed, the one above and the other beneath the nail-blanks, the upper jaw is closed upon the lower by the movement of the levers *j j*, which are operated by the pins working in the frames *xx'*. By this operation the nail-blanks are firmly gripped within the grooves of the jaws, and as the crank-wrist continues to turn, the cams secured to it acting upon the heading tools force them endwise against the extremities of the nail-blanks, which project within the inner edges of the gripping jaws, and thus form the heads of the nails. As soon as the cams pass the ends of the heading tools the latter are moved inwards by the action of their respective springs, and the carriage, with the finished nails in its gripping tongs, is moved away from the cutter-frame by the action of the crank-wrist upon the rectangular aperture in which it moves. As the carriage finishes its backward stroke the frames *xx'* are moved by their pins to turn the levers *j j*, and thus permit the upper gripping jaw to rise under the action of the spring beneath it; as it rises from the lower jaw the discharging piston is depressed by the action of its appropriate driving-pin upon the snug of its lever: as it is depressed its point enters between the two sets of gripping grooves, and its wedge-formed sides bearing against the inner edges of the nails project them laterally from the gripping tongs, thus completing the operation.

Each set of knives act in connection with one set of gripping grooves and one heading tool, and one pair of gripping tongs is advanced by its carriage towards one side of each cutter-frame as the other is drawn away from the other side; the adjacent sets of knives therefore act alternately, and the knife-stock is depressed to cut a nail-blank just before each pair of gripping tongs advances. In order to feed the nail-plate alternately to each adjacent set of knives, the feeder appertaining

to the two adjacent sets of knives on each side of the knife-stock frame is made to vibrate from one to the other by the movement of the feeding carriage. The feeders, it will be perceived, present the nail-plates to the knives in directions always perpendicular to the direction in which the carriage moves, and the knives are equally sloped or bevelled in opposite directions to that perpendicular line in order that they may cut the nail-blank with the proper taper.

It will be perceived that the central carriage has a gripping and heading apparatus at each of its extremities, which act alternately as it is moved alternately towards each cutter-frame. By this arrangement much space is saved, as one carriage is thereby enabled to do the work of two; much machinery is also saved, as the frames *xx'* and their driving-pins, together with the levers *j j*, are constructed in such manner that the one set of gripping jaws is opening when the other is being closed. This arrangement also, by rendering the machine more compact, enables the attendant to supply nail-plates to the feeders with greater ease.

It will be perceived that the gripping jaws open in a direction perpendicular to the face of the nail-plate, and consequently it is necessary to give them a longitudinal movement to draw them out of the range of the descending knife. But this arrangement of the jaws enables me to gripe the nail-blank sideways, without the necessity of turning it upon its edge, which operation is necessary in preceding machines, where the gripping dies open in directions parallel with the face of the nail-plate. It is well known that the mechanism for turning a nail-blank upon edge before gripping it, requires an exceeding nice adjustment, and the difficulty of keeping it in order is one of the principal causes of the misshapen nails which are so frequently made; the adjustment of this mechanism also requires great practical knowledge and experience on the part of the workman, which is unnecessary in machines constructed upon the plan I have described, in which this turning mechanism is dispensed with.

It will be perceived that each knife-stock, in descending, cuts two nail-blanks, one at each of its sides, by arranging the

stationary knives at one side of the knife-stock a little lower than those at the other, and by forming the cam with two grades or steps, the nail at one side of the knife-stock is cut a little after that at the other, by which means the strain upon the machinery is but half of what it would be if both nails were cut at the same moment, and hence there is much less danger of breaking the machine, and a much less strain upon the driving-belt or other mechanism which imparts motion to the machine from the prime mover. It is obvious that this same result will be obtained by arranging the opposite stationary knives at the same height, and by setting the moving knives at different heights upon the knife-stock, so that the edge of one of them shall pass its corresponding stationary knife before the other upon the opposite side of the knife-stock begins to act; this arrangement being the converse of the one described.

Claims.—First—In combination with knives or the equivalent thereof for cutting blanks sidewise from nail-plates, I claim a travelling gripping and heading tongs or jaws opening and closing in a direction perpendicular to the face of the nail-plate, and constructed and actuated substantially, as herein set forth, to gripe the blank on its flat sides, without the necessity of turning it upon edge, as is customary with nail machines heretofore constructed, to draw it from beneath the knives and to hold it while being headed.

Second—The direct acting knife-stock with knives secured to its opposite sides in such positions with respect to the stationary knives or to each other, that the knife upon one side cuts after the knife upon the opposite side, in combination with a double graded cam or other equivalent actuating mechanism, which shall cause the cutter bar to descend with two impulses, at each of which one knife acts to cut a nail-blank.

Third—The relative arrangement of the travelling gripping jaws and heading tool, the latter being actuated within the former and travelling with it.

Fourth—In combination with two sets of knives acting alternately to sever nail-plates, I claim a reciprocating gripping and heading carriage, which, travelling to and fro between the two sets of knives, gripes, heads, and delivers a nail at each single stroke in alternate succession at its op-

posite extremities, whereby much time and labor are saved, and the machinery to cut a given number of nails is condensed into a less space.

ROBINSON'S SEWING MACHINE.

From the Specification of the Inventor, Frederick R. Robinson, of Boston, State of Massachusetts.

FIG. 1 denotes a top view of my sewing machine; fig. 2, a side elevation of it; fig. 3, a front elevation of it; fig. 4 is a vertical section of the two thread-guides, the pressers, the supporting plate, and the rotary cloth-holder. Such other figures as may be necessary to a full and complete description of the invention will be hereinafter referred to and described.

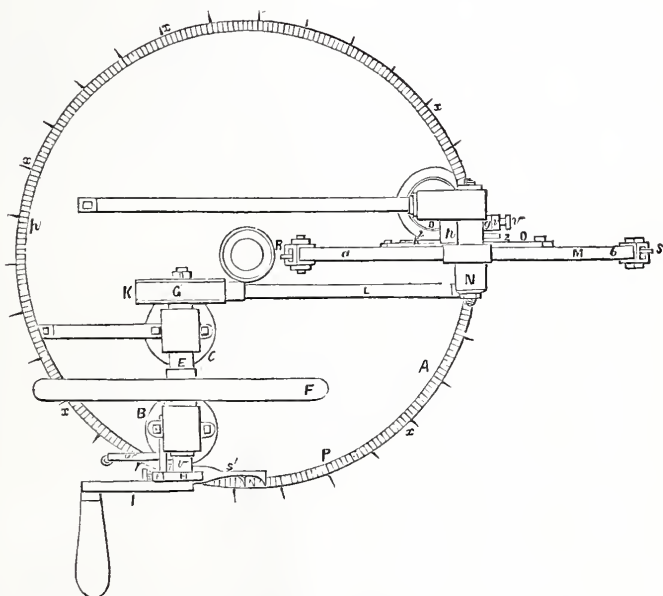
The object of my invention is to produce either what is generally termed stitch and backstitch sewing or ordinary stitching. By "ordinary stitch and backstitch" sewing, I mean that in which a thread, after being carried through a piece of cloth, from its front to its rear side, is moved backwards the width of the stitch, is next again carried through from the rear side to the front side of the cloth, is next carried forwards laterally, double the width of the stitch, or some other suitable distance greater than the width of the stitch, and is next passed through the cloth from its front side to its rear side; such operation being successively repeated in the formation of the stitches.

By "ordinary stitching," I mean that in which a thread is passed through the cloth from its front side to its rear side, is next moved forwards the width of the stitch, is carried backwards through the cloth, from its rear side to its front side, is next carried forwards the width of the stitch, and is again passed through the cloth, from its front side to its rear side, and so on. This is frequently called the running or basting stitch.

Although the elements which constitute the combination of my machine may be adapted to the production of either of the above kinds of sewing, and this by slight changes in the mechanical contrivances by which the motions are produced and regulated, they may also be adapted by the proper changes to the production of the ordinary cordwainer's stitch, which is produced by two threads

which cross one another every time they are passed through the cloth. It is to be understood, however, that the movements of such elements, in order to produce the cordwainer's stitch, must be effected and regulated by suitable mechanical contrivances applied to them; the application of such mechanical contrivances, as well as their selection or adoption, being the work of the mechanic who constructs the machine, and not, generally speaking, one of invention.

Fig. 1.



In figs. 1 and 2, A represents a circular base-plate, table, or stand, on which the operative parts of the machinery are supported, by means of three or any other suitable number of columns, B, C, D, raised vertically thereon; E is the driving-shaft which carries a fly-wheel F. It has an eccentric G on one end, and a cam H on its other; the said shaft being put in motion by means of power applied to a crank I, or in any other suitable manner. The eccentric operates in connection

with the surrounding band K, and its connecting-rod L, to give a reciprocating or pendulous motion to the needle-frame M, which is arranged as seen in the drawings, and is supported upon a horizontal shaft N that projects from the column or pillar D, as seen in the drawings. The said needle-frame is composed of two bars, a b, united together at their upper ends, and connected together at about one-third their entire length below their place of connection, by a circular curved bar or arc o. The lower end of each of the legs a b of such frame carries a curved needle R or S, such needle being made to extend from the inner side of the leg, as seen in the drawings. Each

needle is constructed as represented in side view on fig. 5, on an enlarged scale, that is to say, it is provided with a long eye e, which has a spring f fixed to one end of it, and forming a part of the needle as seen in said fig. 5. Each needle, during the movements of the needle-frame, passes through a slot i, made through the flanch K, which is erected vertically upon the base-plate, and which serves to support a circular hoop P, which I denominate the cloth-holder, and which I shall hereinafter more particularly describe.

The slot or passage i may be about a half an inch in its horizontal length; or it may be of a greater or less length, as circumstances may require. Its width,

Fig. 2.

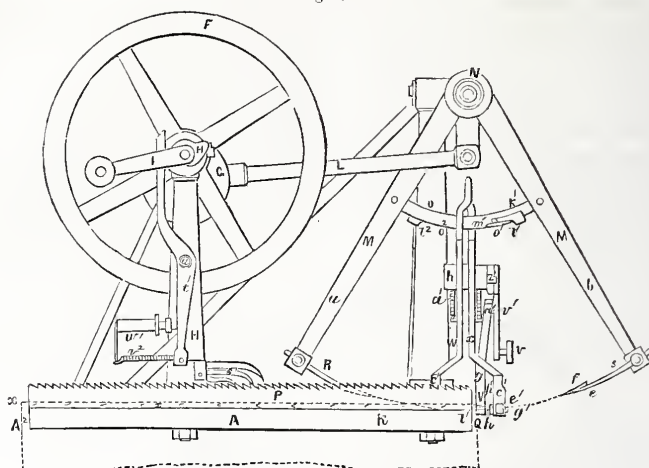
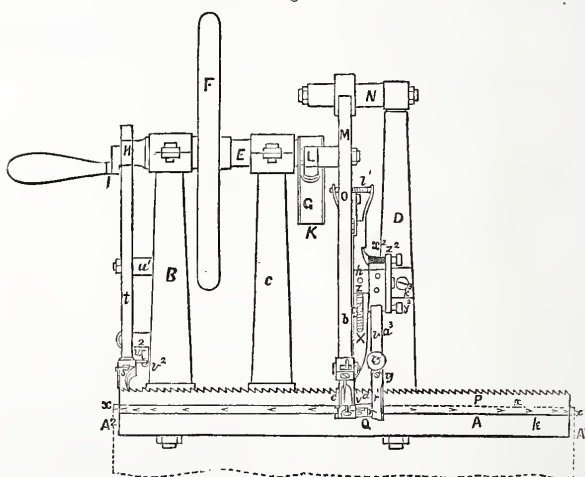


Fig. 3.



vertically, should be sufficient to receive each needle and allow it to freely play through it. The said slot, on its front and rear sides, is provided with a flaring mouth-piece or presser *q*, or *u*, which is formed in its vertical section, as seen in fig. 4. In its horizontal length the flaring mouth-piece should be about that of the slot. That mouth-piece which is on the rear or inner side of the flanch, which supports the cloth-holder, is fastened to the base-plate, whereas the one on the

outer side of the flanch projects from an arm *g*, which extends down from a frame *h*, screwed to the post *d* by means of a screw *k*³. The front mouth-piece is made through a part of a projection *v*, which is arranged in front of the flanch and cloth-holder, and is intended to prevent the cloth from being drawn off the points *x x x* of the cloth-holder during the operations of the outer needle *s*, as well as those of the inner needle *r*.

Fig. 6 represents a front view, and fig.

7 an end view of the projection *v*, the same being drawn on an enlarged scale. In such figures it will be seen that the said projection is provided with a passage-way *r*, of a sufficient depth to receive the points of the cloth-holder, and to permit the free horizontal rotation of the whole series of them, or their horizontal passage through the said contrivance. The arm *g* is hinged at its upper end to the frame *h*, and in such manner as to enable it to be freely moved either towards or away from the cloth-holder; its distance from the cloth-holder being regulated by an adjusting screw *v*, which is screwed horizontally through the lower end of an arm *v'*, which extends downwards from the frame *h*, and so as to bring the adjusting screw directly in front of the arm *g*.

Each mouth-piece should be so made

Fig. 4.

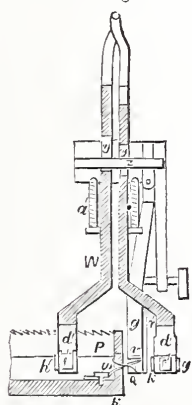
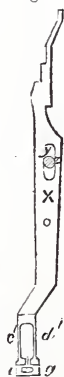


Fig. 8.



as to cause the spring of the needle when it passes through the mouth-piece to close entirely downwards. The thread-guides, which are seen at *w* and *x*, are two bent bars of metal, arranged in the positions as seen in figs. 2 and 3. Both of these bars are adapted to the frame *h*, in such manner as to be capable of being freely and separately moved not only upwards and downwards, but in lateral directions, in planes which may be said to be at right angles to the plane of movement of the needle-frame. Fig. 8 represents a front side view of the outer thread-guide *x* as it appears when detached from the rest of the machinery. Each of the said thread-guides is provided with a slot *y*, through which a fulcrum pin *z* passes, the position of said pin being seen in figs. 2 and 3.

Each of the said thread-guides has one

Fig. 5.

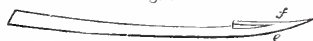


Fig. 6.

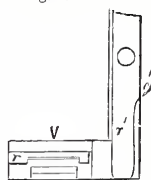


Fig. 7.



end of a retracting spring *a'* attached to it, as seen in figs. 2 and 3; the other or upper end of the said retracting spring being fastened to the frame *h*; such spring being so arranged, and made to operate, as to lift the thread-guide upwards when necessary. The upper arm, or part of one of the thread-guides, is arranged on one side of the curved arc *o*, while the upper arm or part of the other thread-guide is disposed on the opposite side of the said arc; both thread-guides being connected at their upper ends by helical spring *b'*, which draws said ends towards one another. The lower end of each thread-guide is forked; the prongs or sides *c' d'* of such fork being springs,

and made respectively to contain two vertical friction rollers *e' f'*; see figs. 9 and 10, respectively, vertical and horizontal sections of the lower end of the thread-guide, and exhibiting the thread-plates *g' h'*, which are fastened to one of the springs *d'*, and project by the other *c'*.

Each of the said thread-plates has a hole *i'*, made through it for the passage of the needle, which passes through the plates and between the vertical friction rollers.

As soon as either needle enters the cloth, that thread-guide, through which said needle does not pass or extend, should have a lateral motion imparted to

it, far enough to carry it out of the way of the point of the needle. Such lateral motion is given to it by means of one of the two cams κ^1 or κ^2 , arranged upon the side of the arc o , as seen in figs. 11, 12, and 13: fig. 11 being a top view of said arch, and figs. 12 and 13 being respectively views of its opposite sides. The lateral movement aforesaid of the thread-guide being completed, the said thread-guide should immediately have a slight downward movement imparted to it, which movement is effected by a cam l^1 or l^2 , arranged upon the arch as seen in figs. 11, 12, and 13; the cams κ^1 , κ^2 , l^1 , l^2 being made to work against suitable shoulders or bearing faces formed upon

Fig. 9.



Fig. 10.



the upper arms of the thread-guides. Fig. 14 represents an under side view of the arch o , while fig. 15 is a cross section of it, showing the formation of the upper arms of the thread-guides, and their application to the arc o ; on each side of the arch there is a small cam m^1 or m^2 arranged as seen in figs. 12, 13, and 14. The lower side of the arc, between these two cams being a circular arc, such as will produce no vertical motion of either thread-guide while it is moving in contact with it. To each cam m^1 , or m^2 , is applied a continuation o^1 , o^2 of the circular arc or portion between the said cams m^1 or m^2 . This continuation operating to produce no vertical movement of one thread-guide, during such time as the other thread-guide is depressed a short distance by the cam m^1 or m^2 , which is immediately annexed to it.

We will now suppose one of the thread-guides moved downwards into its lowest position, or that in which it should be, to allow the passage of its needle through it. As soon as the needle commences to enter the thread-guides, the cam m^1 m^2 , connected with the arm of the other thread-guide, moves by such arm, so as to allow the retractive spring of the thread-guide to which said arm

belongs, to elevate the thread-guide so as to carry the thread which extends through said thread-guide, above the path of the needle, so that when the thread-guide is next moved laterally, the needle may pass directly under that part of the thread which is between the thread-guides and the cloth. Next, such lateral movement of the thread-guide takes place sufficient to carry said portion of the thread laterally across and over the path of the needle. This having been accomplished by the action of one of the cams which produced the lateral movements as afore described. Next, the thread-guide is depressed a short distance by one of the cams l^1 , l^2 , and so as to fairly lay the thread upon the needle, and behind the rear end of the spring thereof, and so as to cause the thread, on the reaction or return movement of the needle, to be drawn under the spring, and into the eye of the needle, and through the cloth by the needle.

By inspection of the drawings, it will be seen that during each back movement of the needle through the cloth, the spring of the needle is closed down by one of the mouth-pieces or presses, immediately before the said spring is drawn back through the cloth. The mouth-piece or presser becomes necessary when the needle is formed with a spring; but when said needle is made, as represented on an enlarged scale in figs. 16 and 17, the former being a top view of the needle, and the latter a side view of it, such mouth-piece or presser is not essential to the operation of such needle. The needle, as exhibited in the two last-named figures, is formed with a round or elongated eye extending through it; which eye has a diagonal passage-way made into it, as seen in top view in fig. 16.

In sewing with this machine we do not make use of a continuous thread, unwound from a bobbin, as do those machines which produce a chain-stitch, but we make use of a short piece of thread, such as a person uses when sewing by hand with an ordinary sewing needle; and on commencing to sew we simply pass one end of the thread between a spring r^1 and the arm g , against which said spring bears, and we extend the thread and lay it over the back-needle

after it has passed through the cloth, and in such manner as to enable the needle to receive the thread into its eye when the needle is drawn back. The said needle, during its retraction, will draw the thread through the cloth and the back thread-guide, and continue to draw upon the thread until that end of the thread, which was not held by the spring as before mentioned, has been drawn entirely through the cloth and the inner thread-guide. The front needle in the mean time has advanced and passed through the outer thread-guide, and entirely through the cloth, and to the extent of its motion inward.

During such advancement a lateral movement of the inner thread-guide towards the right causes the thread to be laid over the said needle. The needles next are moved forward, and during such movement the thread passes into the eye of the outer needle, is drawn through the cloth and the front thread-guide, and entirely out of the other needle, which passes through the cloth as before, and under the thread, which, by the lateral movement of the outer thread-guide, has been laid or left over it, ready for the next back movement of the needle.

The circular motion of the cloth-holder is to be regularly intermittent, each

Fig. 11.

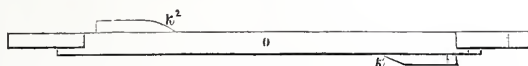


Fig. 12.

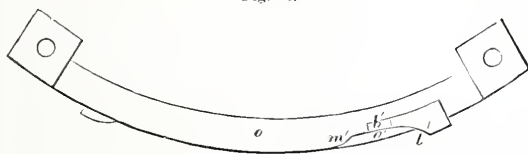


Fig. 13.

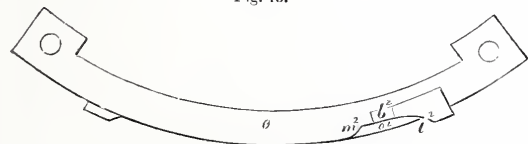


Fig. 14.

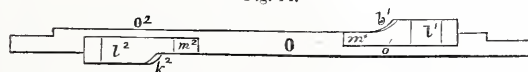
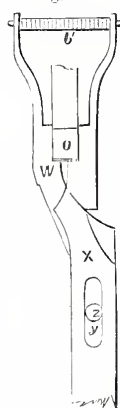


Fig. 15.



movement of it being a sufficient distance to produce the length of each stitch, as required to be made in the cloth.

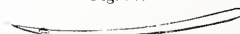
In order to produce the stitch and backstitch, or "forward and backstitch sewing," the two needles must not be arranged in the same vertical plane, but they should be arranged respectively, in two vertical parallel planes, situated, or supposed to be, at a distance apart from one another equal to the length of a stitch, the outer needle being placed on the right of the other. The cloth-holder is to be moved forward only during each

outward movement of the needle-frame, and such motion should take place while the needles are out of the thread-guides or cloth. The machinery which pro-

Fig. 16.



Fig. 17.



duces the intermittent circular motion to the metallic hoop or cloth-holder is as follows:

The upper surface of the cloth-holder has a series of ratchet teeth formed en-

tirely around it; one or more pawls or ratchet *s'*, jointed to the lower end of a lever *l'*, works into said ratchet teeth. The said lever *l'* moves upon a fulcrum at *u'*, as seen in figs. 2 and 3, and is moved in one direction by the action of the cam *h*, and in an opposite direction by a retracting spring *v''* affixed to it, and to a stationary arm *w'*, arranged as seen in the drawings.

In the adaptation of my machine to the production of ordinary stitching, that is to say, stitching without a backstitch, the two needles must be arranged in the same plane with each other; while a forward movement of the cloth-holder should take place during each movement of the two needles either outward or inward. The cloth-holder has a series of points projecting from its outer surface, and close to its lower edge, and at suitable distances apart from one another. The cloth to be sewed is placed upon these points, as represented at *A*² by dotted lines.

The friction rollers of the lower ends of the thread-guide are sprung together by the springs so as to firmly hold the thread when passed between them.

Each thread-guide has a stop-screw *x*² or *y*² applied to it, as seen in fig. 3; the two stop-screws being screwed respectively through projections *z*² *a*³, the whole being arranged in such manner as to enable the screws to serve as rests or stops for their respective thread-guides, to bear against under the draft of the connecting spring at the upper ends of the thread-guides.

I claim the combination of two needles, two thread-guides, and a cloth-holder, made to operate together substantially in the manner and for the purpose as herein before set forth. Also, the improvement of making the needles with springs, and applying mouth-pieces or pressers to them and on each side of the flanch of the base-plate—the whole being substantially as above described.

HAPPERSETT'S IMPROVEMENTS IN ROLLING IRON.—MECHANICAL HOOKER-UP.

From the Specification of the Inventor, David J. Happersett, of Downingtown, Pennsylvania.

FIG. 1 represents a view in perspective of a boiler-plate mill with my invention

applied thereto, and fig. 2 is an elevation of the friction-wheels detached from the mill.

In those rolling-mills in which the metal is passed several times in succession between a pair of rolls which revolve continuously in one direction, it is necessary that the mass of metal which has been introduced between the rolls at one side of the mill, and has been delivered by them at the opposite side thereof, should be raised and passed over the top roll to the front of the mill, in order that it may again be introduced between the rolls. When the weight of the mass being rolled is not very great, the common device employed for raising it is a hook-formed lever, which, being suspended at a point between its two extremities, is manipulated by an attendant, commonly called the hooker-up, who inserts its end beneath the mass delivered by the rolls, and bearing upon the opposite end of the lever, raises the mass sufficiently to permit it to be shoved forwards over the top roll. This method of working is very convenient, so long as the mass can be raised by a single workman; but it is extremely inconvenient and costly when the mass is so heavy that it requires the combined exertions of a number of men to raise it sufficiently to permit its passage over the top roll.

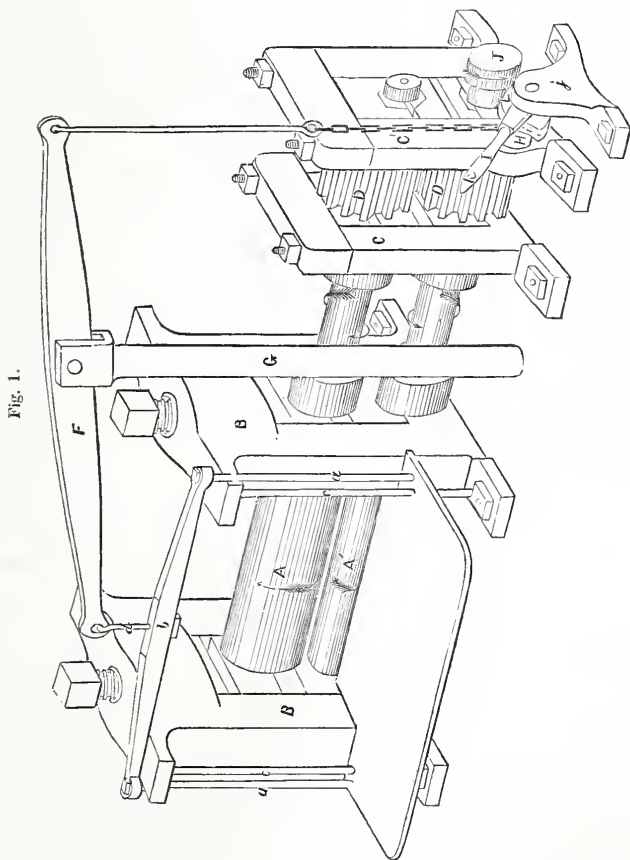
The object of my invention is to raise the mass, however large and heavy, by the action of mechanism which is connected with the rolls, and can be readily and instantaneously brought into action to raise the mass, and to hold it when raised, until it is passed over the top roll, and can be lowered instantaneously to the proper position for receiving the mass delivered by the rolls, by the work of a single boy.

The apparatus I am about to describe is represented in the accompanying drawing, as applied to a boiler-plate mill; *A A'* being the two rolls, *B B* the housings thereof, and *cc'* being the housings of the pinions *D D*, by which the upper roll is put in motion from the lower. The rolls are driven in the usual manner in the directions respectively indicated by the arrows in the drawing. My apparatus is applied to the back of the mill, or to that side at which the rolls in their movement deliver any thing inserted between. It consists mainly of a plate *E* to

receive the mass delivered by the rolls of a lever *F*, from which this plate is suspended, and of the mechanism by means of which the lever is moved to raise or lower the plate. The plate *E* is connected by two suspension rods *aa*, with a cross-head *b*, above the housings *B B*, and is guided in rising and falling by two guide-rods *cc*, which are passed through

suitable holes in the opposite extremities of the plate, and are firmly secured to the housings of the rolls.

The cross-head *b* is suspended at its middle by a link-bar *d*, from the extremity of a lever-beam *F* above. The latter is pivoted near its middle to a standard *G*, which is erected between the roll and pinion housings; its extremity *e* is con-



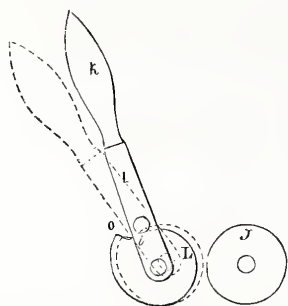
ected by a rod and chain *f* with the barrel of a drum *H*, one of whose gudgeons is pivoted in the adjacent pinion housing *c'*, while its opposite gudgeon is pivoted in the lower extremity of a lever *I*. This lever is pivoted near its lower extremity to a standard *j*, erected upon the bed-plate of the mill; its upper extremity is

prolonged and rounded to form a handle *k*, by moving which the lower extremity of the lever and the end of the chain-drum connected therewith, can be moved towards or from the spindle of the adjacent pinion. This pinion-spindle is fitted with a circular friction-drum *J*, and a similar drum *L* is secured to the chain-drum

n, in such a position with respect to the friction-drum j on the pinion-spindle, that its periphery can be pressed forcibly against that of the latter by moving the lever-handle i.

The friction-drum L is cylindrical throughout only a portion of its periphery, which terminates in a hollow space i, and is succeeded by a lump or snag o. The hollow space is of a form to fit the periphery of the friction-drum on the pinion-spindle, and the lump o is sufficiently large to bear upon this latter drum, and prevent the further revolution of the drum from which it projects.

Fig. 2.



When the mill is in operation, the rolls, pinions, and friction-drum j revolve continuously in the directions indicated by the arrows in the drawing. The mass of iron is introduced between the rolls, and as they revolve is delivered by them upon the plate E, where it is seized with a fork or tongs by a workman standing behind the rolls; the boy, standing with his hands upon the lever-handle i, now bears upon it, and thus forces the periphery of the friction-drum L against the moving periphery of the corresponding friction-drum j on the pinion-spindle; the friction of the latter upon the former is sufficient to cause it and the chain-drum n to turn, thus winding up the chain, and depressing the one extremity of the lever-beam f to raise its opposite extremity and the plate suspended therefrom, together with the mass of iron which has just been delivered by the rolls and lays upon the plate.

This raising of the plate E is continued until the hollow portion i of the friction-drum L coincides with the periphery of

the drum on the pinion-spindle, and the lump o upon the former bears upon the latter, when the further revolution of the chain-drum and the corresponding elevation of the plate is stopped, and the plate E is thus held in its raised position until the mass laying upon it is transferred over the top roll to the front side of the mill.

As soon as the mass is moved off the plate, the boy raises the lever-handle, thus moving the friction-drum L out of contact with that upon the pinion-spindle, when the plate E, being no longer held up, drops by its weight to its lowest position to receive the mass again delivered by the rolls.

The chain-drum is of such size that it will wind up a sufficient length of the chain to raise the plate, in turning only a portion of a revolution; and the chain is attached to the drum in such manner that the lump of the one friction-drum will bear upon the periphery of the other, and thus prevent the further upward movement of the plate, when the latter has reached its highest position.

The apparatus thus described may be termed a mechanical hooker-up. It is peculiarly adapted to rolling-mills, as it can be brought into action at any required moment when the mass has passed through the rolls; it also possesses the peculiarity of permitting the operator to stop and hold the plate in its highest position, and to drop it immediately to its proper position to receive the mass issuing from the rolls; and it is not only extremely simple in its construction, but also is free from the defect of requiring cog-geer, or other frangible mechanism, which would be subjected to continual breakage by the jar in throwing the apparatus into or out of action.

I claim the combination with a plate, or the equivalent thereof, for receiving the mass issuing from a rolling mill, the friction-drums, the periphery of one of which is shaped substantially as described, and operating substantially as herein set forth, in such manner that by their action the plate, or its equivalent, is quickly raised and held stationary at the proper height to permit the mass upon it to be passed to the front side of the mill, and is rapidly lowered to the proper position to receive the mass issuing from the rolls.

MILLER'S BOILERS.

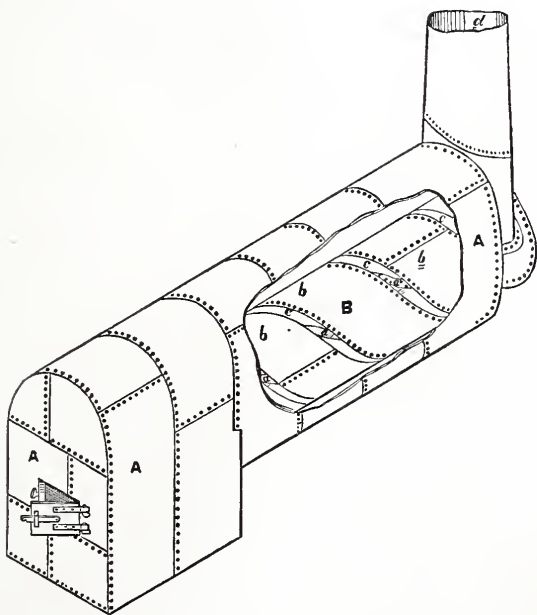
From the Specification of the Inventor, Benjamin J. Miller, of the City and State of New York.

THE nature of my improvement consists in the application to ordinary low-pressure boilers, flues of a spiral form, as hereinafter described, for the purpose of obtaining more compactness and strength than in the common method.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation, reference being had to the drawing herewith accompanying.

A represents the exterior or shell of a steam-boiler and furnace of common construction, with an opening in one side, through which may be seen the spiral flue. The flue B is composed of a small cylinder or core *a*, and a larger cylinder

b, forming the exterior circumference of the flue, the cylinder being concentric; a spiral slot or opening corresponding in each, extends from one end of the flue to the other, and the slot or opening thus made is preserved, and the flue made complete, by closing or joining the corresponding spiral edges of both cylinders, so that water may flow from the inside of the inner cylinder to the outside of the outer one, and the flame or heated air pass through the inclosed channel between the outside surface of the inner cylinder and the inside surface of the outer one, until it reaches the chimney *d*. I make use of brace or socket bolts to give stability to such parts of the flue as may, from its size or circumstances, require support or strength.



STEAM-CARRIAGE FOR PLANK-ROADS AND
SMOOTH PAVEMENTS.—IMPROVEMENTS
BY J. K. FISHER.

WE call attention to the plans of Mr. Fisher for travelling on plank-roads by steam-power. He has been laboring for
VOL. I.—42

some twelve years or more on this subject, and has taken measures to secure a patent for the improvements which, in his opinion, render the project feasible.

He will, at his rooms, 179 Broadway, be pleased to exhibit his models and

drawings, which are well worth the examination of capitalists about to embark in plank-road construction.

The following reports from committees of the American and the Mechanics' Institutes, of this city, will show that the project is favorably regarded by men whose opinions are entitled to the highest consideration.

AMERICAN INSTITUTE, }
Sept. 4th, 1851. }

The following Report was read, accepted, and ordered on file, viz.:

Your committee, to whom was referred the consideration of Mr. J. K. Fisher's improvements in plank-road steam-carriages, beg leave to report as follows:

The carriage presented by Mr. Fisher embodies a number of new and important improvements, both as regards its general arrangement and the application of steam. He has introduced a new method of working steam expansively, by means * * [*we do not give the description, as it might prejudice the inventor's interest in foreign countries*]. * * We think it highly successful and effective. The arrangement for cutting off the steam at different points of the stroke is equally as effective as the main movement.

The combination of the radius and parallel rods, to afford steadiness to the machine, even at high velocities, is certainly a very great improvement, particularly if the machinery and carriage are sustained upon easy springs, as in the arrangement presented in the model. By this arrangement, it should be observed, all the weight of the heavy framing hitherto used is dispensed with, thereby giving greater capacity for carrying passengers.

The whole of the machinery, including the apparatus for steering, is so planned that only one person will be required to manage a carriage.

We consider the model presented by Mr. Fisher capable, with some slight modifications, of affording a very superior plan for steam-carriages to run on good level roads.

JAMES RENWICK, Chn.,
(Signed) HENRY R. DUNHAM,
H. MEIGS,

Committee.

MECHANICS' INSTITUTE, }
Sept. 9th, 1851. }

The Committee on Arts and Sciences have had referred to them the improvements in steam-carriages for common or plank roads, by Mr. J. K. Fisher: they appear to possess several advantages over those formerly experimented upon. The cut-off, to work the steam expansively, is a very ingenious contrivance, and is so arranged as to cut off the steam at any part of the stroke; and it would answer for fixed engines, as well as for steam-carriages.

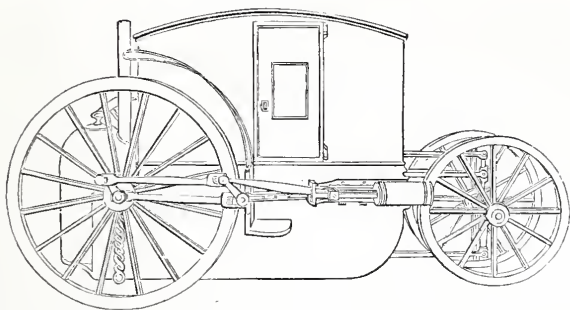
The backing or reversing motion appears to be very well arranged.

The attaching the engines outside the wheels, as is done in some locomotives, instead of cranking the axletree, as was done in most of the English carriages, is, we think, a decided improvement; and, taking the arrangement altogether, your committee think it worthy of the favorable consideration of the Mechanics' Institute.

CHAS. W. COPELAND,
(Signed) J. STONE,
JAMES BOGARDUS,
Com. on Arts and Sciences.

The slight modifications alluded to in the report of the American Institute, relate to the apparatus for varying the time of cutting off: they are deemed too complex to bear the jolting of common roads. But, although there is some complexity in those parts, worked only occasionally, which are necessary to vary the cut-off, the whole valve-movement is composed of fewer parts than the movements generally used on locomotives, which do not vary the cut-off, but work either at half-stroke or full stroke. If only the half-stroke cut-off be required, Mr. Fisher's movement can be simplified so that the total number of its parts will be only half that of common locomotive valve-movements, and these parts will be less heavy and complex than those in use.

In the common movement there are eighteen principal parts constantly acting, and ten parts occasionally acting, twenty-eight in all; and counting all the subdivisions, screws, nuts, rods, bars, &c., the total number is one hundred and ninety. Mr. Fisher's movement, which has the advantage, important for a common-road carriage, of working at half-



stroke with one engine while the other works at full stroke, is composed of twelve principal parts constantly moving, and two occasionally acting, fourteen in all; and counting all the subdivisions, boxes, screws, &c., the total number of parts is sixty-four, only a third of the total number in the common movement, and the parts are smaller, and less subject to jolting.

But when it is required to vary the cut-off at pleasure, while the carriage is running, the number of principal parts constantly working will be twenty-two, two more than in the common movement, and those occasionally working will be ten, thirty in all; and counting all the subdivisions, one hundred and twenty-nine parts—sixty-one less than in the common movement. And it may be observed, that if the complex part objected to, the gearing for timing the cut-off, should be broken, the engines would not thereby be stopped, but would work at full stroke, or cut off at the latest point determined by the construction. And we think that the tenderness of this gearing, which works only when the cut-off is to be varied, is not a sufficient reason for foregoing the advantages of a variable cut-off, which will be brought into view in what we have to say upon the subject of working on roads.

The *practicability* of locomotion by steam on common roads is an established fact; several English inventors have run earriages which did efficient service, and were perfectly under control: they emitted no visible smoke or steam; made no noise, except with the wheels; and they were not in any way disagreeable. But their *profitableness* is a point not yet established. Nor is the contrary proved

by their failure to get into general use in England; for there are many reasons, apart from the defects of the carriages, why they should not have done so well there as they might do elsewhere. First, railroads occupy all the long lines of travel. Where capital is abundant, and freight and travel such as they must be with a dense and active population, the hard iron rail makes the most economical road. Second, it is a well-known fact that those carriages were not managed with economy: some required three men to work them, a steersman, an engineer, and a fireman, who, besides his peculiar duty, worked the breaks. And third, a violent opposition from the agricultural interest, prompted by the consideration that they would diminish the demand for horsefeed, continually annoyed, and at last broke down, the projector, Mr. Gurney, who ran carriages in the country.

In our country, for years to come, there will be long lines of travel upon which railroads will not pay a profit, owing to the high rate of interest, and the scantiness of the business: upon these lines cheaper roads must be used, as precursors to railroads. And it will be seen by the above report that a carriage may be so arranged that only one person will be required to manage it, thus saving the wages of two men,—which alone would afford a handsome profit on a carriage. As for the opposition of any parties, we apprehend that there is too much good sense to allow it.

But there is one new element, in this country, which, above all others, will operate in favor of steam-carriages; we refer to plank-roads, which have not been used in England, nor anywhere until

within sixteen years. The power required to draw a load upon them is about a third of what is required upon a good Macadamized road, upon a level; and they are usually graded so as to avoid steep ascents. According to Parnell (*Treatise on Roads*), a pull of seventy pounds is required to draw a ton upon a Macadamized road in ordinary condition: on a plank-road a pull of twenty-three pounds will draw a ton, even when there is dirt upon it, as is usually the case. But if they were kept clean, as they would be if steam-carriages were in general use, probably a much less pull would serve; for upon stone tracks only twelve and a half pounds will draw a ton. Now hard planks, laid lengthwise, and kept smooth and clean, should not require much more power than stone tracks. We may, therefore, confidently expect that roads of this kind will be laid on the new lines of travel, and be used until the increase of business will warrant the perfecting of the grades, and the substitution of iron rails. Until this time we shall have many roads, suitable for steam-carriages, which will require but one-third of the power required upon the English roads, upon which their steam-carriages worked.

The advantage of this may be briefly shown by a statement of the weight and power required to run a small carriage, to carry four to six persons, upon roads of different kinds. Weight of the carriage, six hundred pounds; machinery and water, about four hundred; load, six hundred; total, sixteen hundred. On a gravel road the pull, 147 lbs. per ton, will be 112 lbs. upon a level; to ascend a hill rising one in twelve, such as often occurs, 133 pounds additional pull, making a pull of 245 pounds, which the engines must be capable of exerting. Suppose that the boiler is large enough to take the carriage up such a hill at three miles per hour, it will run at the following rates upon a level, upon different roads: On gravel, cutting off at half stroke, $9\frac{3}{4}$ miles; on a Macadamized road, 17 miles; on planks, 27 miles,—the consumption of fuel per hour being constant. Hence it appears that the same force of steam, or fuel, besides overcoming the friction and other resistances of the machinery, will work sixty per cent. more effectively on planks than

it will on Macadamized roads, and nearly three times as effectively as on gravel roads, so far as increase of speed is concerned.

If, instead of increasing the speed, we increase the load, we may draw upon the Macadamized road, upon a level, an additional carriage weighing with its load twenty-one hundred pounds, and carrying nine passengers. Upon a plank-road we may draw six additional carriages weighing with their loads sixteen hundred each, and carrying altogether forty passengers. Thus, as to the cost of the motive power to do the same work, it is more than three times greater on the gravel than on the Macadamized road, and eleven times greater than on the plank-road; and on the Macadamized road it is three and a third times greater than on planks. These considerations show that it is not unreasonable to expect a profit upon plank-roads, even though it were certain that none could be made upon Macadamized roads.

As to what may be done on common gravel roads, and others of a worse quality, it is only claimed that carriages may be run over them at a slow rate, with a large consumption of fuel. This has actually been done in England. So, if it be required that a carriage should deviate from the good road, for the sake of going to a place on a bad one, it can do so.

In the foregoing estimates we have proceeded upon the supposition that the grades should correspond to the quality of the roads. This is true to a certain extent, the plank-roads being graded with great care; and on the prairies there are some which scarcely depart from a level; but in practice the loads would be lighter, and the speed greater, than we have assumed in the latter view: a compromise between the greatest speed and the greatest load, suited to the exigencies of business, would be made in each case.

We have also supposed that the cut-off would be at half-stroke. This is in accordance with the views of several eminent engineers, who are extremely fond of simplicity, even in the light and subsidiary parts of machinery; and if the work were upon level grades, with resistances varying but slightly, there might be no sufficient reason to pay the first cost, and perhaps the cost of repair-

ing, of a complex apparatus for varying the cut-off. But as the total resistance, including the back-pressure in the cylinders, the friction, etc., will be ordinarily not more than a fifth of what the engines must be able to overcome, in order to get over hills on bad roads, we think that, upon mature consideration, the variable cut-off will be regarded as indispensable, where speed is required. The following comparison will show the advantage of it:

The power necessary to run on a level, on gravel, is $\cdot 52$ of what is required to ascend such a hill as we have described. By reference to tables of expansion we find that, the pressure remaining constant, we may cut off at a fifth, and have sufficient power to overcome the resistance. Hence we may run fifteen miles per hour, on a level, with a boiler that will go up hill* only at three miles, when working at full stroke; and we have before stated that when cutting off at one-half, we can run but nine and three-quarters. On a Macadamized road the power required is only $\cdot 3$ of what is required to ascend a gravel hill. By reference to tables we find that cutting off at one-eighth will give $\cdot 399$ of the force of a full cylinder. Hence we may run twenty-four miles per hour, and yet diminish the pressure considerably. But when cutting off at half we can run only seventeen miles, at the same cost. On planks the resistance is less than a fifth; and cutting off at a tenth will give nearly a third as much power as the full stroke: hence we may run, if required, nearly fifty miles per hour, on a smooth plank-road, with the fuel required to run twenty-seven miles in the same time when working at half-stroke. Or, if such speed be not required, we may check the fire, which will allow the heat to be more effectually abstracted from the smoke; and in either way fuel may be saved.

The tables we have referred to were constructed without regard to the fact that the pressure of steam diminishes in a greater ratio than its density; but this objection applies with more force to the lower-pressure method, that is, the half-stroke mode of working. It may also be objected that the loss of heat is

greater when the pressure is kept up; but in general it has been found that it must be kept up in the boiler, by using the throttle-valve; and for what may be lost in the cylinders the greater proportionate force of high-pressure steam will probably compensate.

There is, however, one valid objection to the use of a very high pressure when running fast: it is this, that the jolting tends to strain the carriage; the engines, therefore, should, at such times, not be allowed to act with their full force at any part of the stroke, lest the combined effect of the engines and a jolt should break some part. A compromise between the two principles, to such an extent as to obviate this danger, would be adopted, as experience might determine.

All the advantage of working expansively the English carriages neglected. It is, indeed, said, in some work we have read, that Gurney used a cut-off; but Mr. Stone, a member of the committee of the Mechanics' Institute, who was his machinist, and often guided his carriages, informs us that he did not use it. And this neglect, we think, was one principal reason for the doubtful success of his invention. If we compare the theoretical performance with the foregoing estimate of the results of the half-stroke and the variable cut-off, we shall see a remarkable difference. Working at full stroke will produce, on a level, on gravel, $5\cdot 7$ miles per hour; on a Macadamized road, 10 miles; and on planks, 16 miles: in a tabular form, speed in miles per hour,

	At full stroke.	Half- stroke.	Cut-off varied.
On a gravel hill,	3		
“ “ level,	$5\cdot 7$	$9\cdot 75$	15
Macadamized road,	$10\cdot$	$17\cdot$	24
Plank-road,	$16\cdot$	$27\cdot$	49

This shows that to attain the moderate speed of fifteen miles per hour, at which he usually ran, he must have had one-half more heating surface and water and fuel than are required; but he ran up hill at ten or twelve miles, consequently his heating surface must have been more than three times what was needed, and, of course, a proportionate part of the load displaced,—in other words, the profit diminished.

Moreover, a writer in the *Edinburgh Encyclopædia*, supposed to be Mr. Scott

* By hill is to be understood a rise of 1 in 12, or 440 feet per mile.

Russell, says that all the carriages made in England were enormously heavy; compared with what they should be, they were like the lumbering coaches of Elizabeth's time compared with the "light and elegant vehicles of the present day" in England; which lightness, we may remark, is about four times the weight of light American carriages. The surprise recently excited in the World's Fair, by light vehicles from the United States, shows that the minimum of weight has not been attained in England.

In accordance with these views, Mr. Fisher has based his calculations upon the advantages of plank-roads, of the lightness that may be attained by the variable cut-off, and of the lightness of structure which distinguishes American carriages above all others. And we think that his machinery and boiler are adapted to give the full effect of the principles he has adopted.

To ascend one mile upon a gravel hill will require about thirty pounds of water, to vaporize which, from three to four pounds of fuel will be required. Hence the fuel, at the largest estimate, will be four pounds per mile up the worst hills, eight-tenths of a pound on a gravel road, half a pound on a Macadamized road, and a quarter of a pound on planks. Upon a Macadamized road, on an average of hill and level, we may assume it within a pound per mile. Granting that a pair of horses can draw four persons sixty miles per day, which they cannot do for many days in succession without injury, we have sixty pounds of coal representing the day's work of two horses, at a cost of fifteen cents, or fifty-three cents per week for each horse-power, which is probably less than a fifth of what it actually costs to keep a horse in the city. And as the first cost of machinery will be less than that of the number of horses required to run a carriage eighteen hours per day, or even twelve hours, it must be evident that the use of steam on roads will be economical, even at moderate speed.

Another saving will be made upon the wear of roads, more than half of which is due to the feet of horses; and upon plank-roads a far greater proportion is due to this cause, especially in the winter, when horses are sharp-shod. The tolls might be reduced; or if plank-road companies should run such carriages, they

would find them highly economical. In cities the wear of pavements would be less than half, and the cost of street-cleaning in the same proportion. And if india-rubber or gutta percha tires should be found as economical as they are said to be, the wear and dirt and noise would be nearly avoided.

The foregoing estimates have been made for moderate speed; but when more than ten miles average per hour is required the economy will be much greater. To run such a carriage twelve miles per hour, for twelve hours per day, would require at least twelve first-rate horses, at a cost of five dollars per day. The cost of fuel and oil to do this work may be assumed at less than fifty cents. As for fifteen or twenty miles or more, it is not to be got from horses at any cost that will be paid. But we have shown that any speed within the limits of safety may be attained by steam-carriages, at a comparatively trifling cost. If we leave off one passenger and add his weight to the heating surface of the boiler, we may more than double the speed.

The outline represents the external appearance of the carriage. It is not deemed expedient to show or describe the internal arrangements, as such publication might prejudice the patent right in foreign countries; but to those who may wish to examine them with a view to interest themselves in the invention, Mr. Fisher will be happy to afford full information, at his room, 179 Broadway.

The boiler, engines, and pipes are all outside; the pipes being on the right-hand side, for convenience. The cylinders are inclosed in casings of bright metal. The motion is given first to a slender crank-shaft, whose cranks serve to keep the ends of the connecting-rods in circular paths; and from the connecting-rods it is transmitted by coupling-rods to the main cranks upon the axle of the driving-wheels. The axle is attached to the fixed bearings of the small crank-shaft, by two rods, parallel to those that couple the crank-pins. The joints between the connecting-rods and coupling-rods are so formed that their friction is only equal to that of the joints between the connecting-rods and piston-rods; and all the joints of the connections allow of lateral and twisting motion. The uses of this combination of rods are, to prevent

a rocking and shaking motion, and to allow of free play to the axle. Mr. Fisher claims the combination as his invention:—a part of it, however, the small crank-shaft, has been patented in England; but he has evidence of priority of invention. The carriage is suspended by spiral springs from the main axle, and by the springs which are jointed to the spindle in which the fore axle is held, by a joint that admits of a limited motion in the plane of the spindle. To the top of the spindle a lever is fixed, which passes through a slot into the carriage, by means of which the carriage is steered by a person upon the middle seat, the end of which passes through the side, and serves as a step. The back seat is on the same level. The front seat, which is to be used only for light persons, is formed by the boards to which the engines are bolted. In carriages of this size, which are intended for hackney coaches, the front of the covering will be at the back part of these cross-boards; and the steersman will sit upon this seat outside. This way of attaching the engines is believed to be new, also the attachment of the steering-wheels, and they are claimed as the patentable property of the inventor. The bottom of the carriage is intended to run about six inches from the ground; the driving-wheels are five feet high; the steering-wheels three and a half feet, the distance between them about sixteen inches; and the whole length of the carriage is twelve and a half feet. The engines are reversed by means of a valve.

(To be continued.)

BOILER OF THE U. S. STEAMER "HARNEY."

For Appletons' Mechanics' Magazine.

THE "HARNEY" was a small steamer belonging to the government in 1845. I have taken from her log the following mean performance of her boiler: the fuel used was Southern pitch-pine.

The boiler was 17 feet 11 inches in length, 8 feet 6 inches in width, 8 feet 9 inches in height for the length of the furnaces, and 7 feet 9 inches for the remainder of the length. The sides of the shell were vertical, and the top was a curve of three centres, struck with radii of 2 feet 6 inches and 4 feet 9 inches.

There were two furnaces, each 3 feet

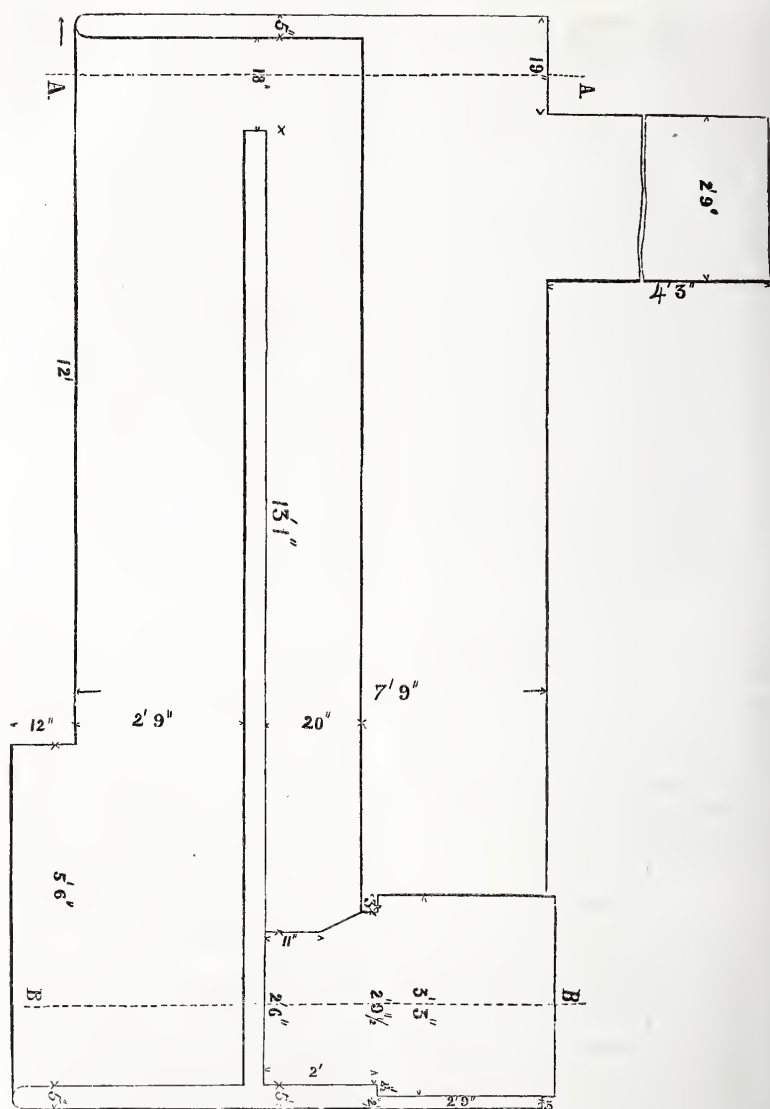
7½ inches broad, and 5 feet 6 inches long, with straight sides and a curved top, struck with radii of 10 inches and 4 feet 6 inches: this arch was continued 10 feet 1 inch to the back of the boiler, forming a continuation of the furnace, from which it was separated by a bridge-wall of brick; at the back of the boiler it communicated with the return-flues, which were 20 inches in diameter, 13 feet 1 inch in length, and two in number to each furnace. At the forward end of the boiler they discharged into the smoke-chimney, 3 feet 3 inches in diameter, and about 45 feet in height above the grate-bars. The water-legs and water-sheet spaces were 5 inches thick. There was no water bottom, but the bottoms of the arches were formed by a piece of iron riveted across between the legs, and covered or paved with brick.

The total amount of grate-surface is 39·94 square feet; of heating surface 608 square feet. Cross-area of the arches 18 square feet; of the flues 8·72 square feet; of the smoke-chimney 8·30 square feet.

With these dimensions, the boiler supplied one cylinder of 34¾ inches diameter and 8-foot stroke of piston, cutting off at half-stroke, with steam of 20 pounds boiler-pressure above the atmosphere, for 36 strokes of piston per minute; consuming 92 cubic feet of Southern pitch-pine per hour.

The "cutting off" was effected by the old-fashioned cam-board cut-off valve, placed in the steam-pipe, which left 7 cubic feet of space to be filled with steam between the cut-off and steam valve. From the steam-valve to the cylinder piston, including clearance, there was an additional space of 1·45 cubic feet. The steam-valve was 11¼ inches in diameter.

The space displacement of the steam-piston was 52·688 cubic feet, half of which is 26·344 cubic feet, to which must be added the 1·45 cubic feet between the steam-valve and piston, making 27·794 cubic feet. Now, the total space occupied by the steam at the moment of cutting off at half-stroke was this 27·794 cubic feet, added to the space between the cut-off and steam valves, viz., 7 cubic feet, making a total of 34·794 cubic feet of steam expanded into a space of $(52·688 + 1·45 + 7)$ 61·138 cubic feet; or the space filled with steam



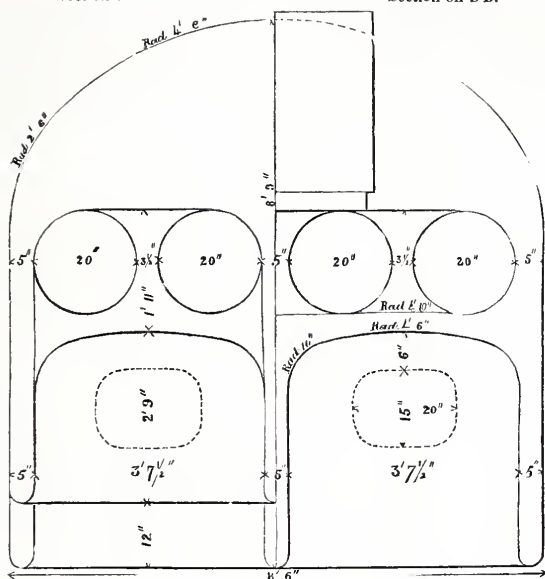
per stroke of piston was $58\frac{1}{2}$ per cent. of the space into which the same steam was expanded. $58\frac{1}{2}$ per cent. of the steam between the cut-off and steam valves, or 4.095 cubic feet, would be lost per stroke; adding this to the 27.794 cubic

feet between the steam-valve and half-stroke of the piston, we have 31.89 cubic feet of steam expended per stroke of steam-piston.

The boiler steam-pressure per gage was 20 pounds per square inch above

Section on A A.

Section on B B.



the atmosphere; but with the given area of steam-valve and speed of piston, probably entered the cylinder at about 1.7 pound less pressure, or making the total initial cylinder pressure 33 pounds per square inch. The relative volumes of steam of this pressure, and water, is 810 to 1. The cubic feet of steam used per hour was $(31.89 \times 36 \times 60) 68882.4$, which, by the above proportion of 810 to 1, would require 85.04 cubic feet of water for its generation. Taking the cubic foot of sea-water at 64.3 pounds, there would be evaporated 5468.07 pounds of water; to this must be added the loss by "blowing off" one-half the water pumped in, to maintain the saturation at $\frac{2}{3}$, or 14.94 per cent. more, obtained as follows, viz.:

Taking the sum of the latent and sensible heats of steam at $(990^\circ + 212^\circ) 1202^\circ \text{ F.}$, the temperature of steam of 33 pounds total pressure at 257° F. , and the temperature of the feed-water from the hot-well at 100° F. , we have for the amount of heat absorbed in the *evaporated* half of the water 1202° , and in the *blown-out* half $(257^\circ - 100^\circ) 157^\circ$, and 157 is 13 per cent. of 1202, leaving 87 per cent. of the total caloric imparted to

the water to be employed in converting it into steam; and if 87 per cent. evaporates 5468.07 pounds, 100 per cent. would evaporate 6285.14 pounds, which is then the amount evaporated per hour by 92 cubic feet, or nearly three-quarters of a cord, of pitch-pine wood. Allowing the weight of a cord, or 128 cubic feet, of this wood to be 2600 pounds, 92 cubic feet would weigh 1909 pounds, giving an evaporation of 3.29 pounds of water per pound of wood, and burning 47.8 pounds of wood per square foot of grate per hour.

The proportions of the boiler were as follows, viz.:

Proportion of grate to heating surface, 1.00 to 15.23.

Proportion of cross-area of arches to grate surface, 1.00 to 2.22.

Proportion of cross-area of flues to grate surface, 1.00 to 4.58.

Proportion of cross-area of chimney to grate surface, 1.00 to 4.81.

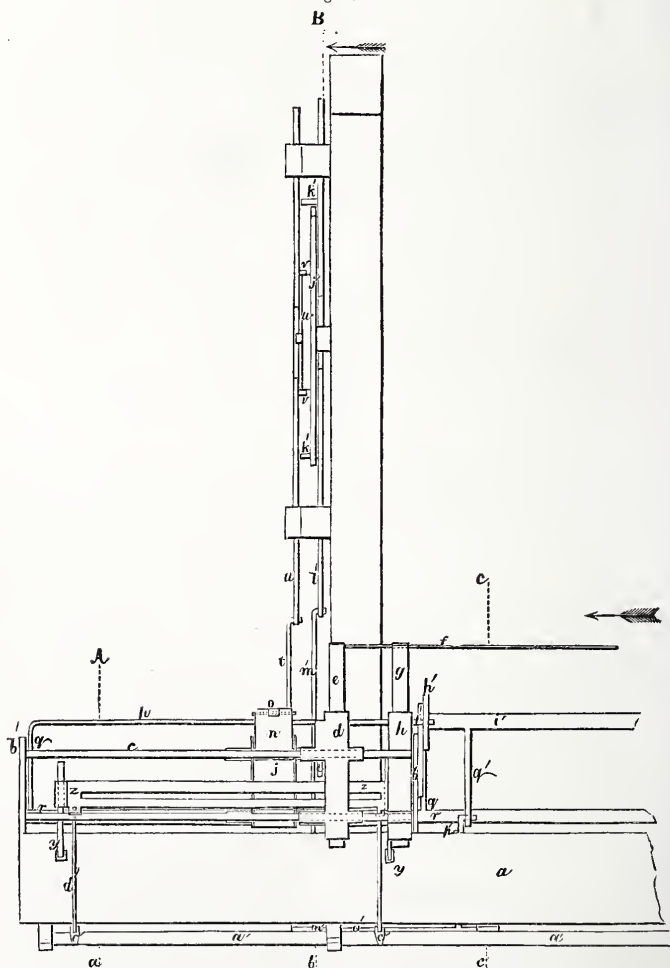
Proportion of cubic feet of space displacement of piston to heating surface per double stroke of piston, 0.62.

Pounds of water evaporated per square foot of heating surface per hour, 10.34.

It will be observed that the draught could not fail to be very powerful with the above proportions of boiler; the calorimeter of area of flues being an excessively high proportion, while that of the

heating to grate surface was very low. The great strength of the draught is further evidenced by the enormous combustion of 47·8 pounds of wood per square foot of grate per hour. B. F. L.

Fig. 1.



IMPROVEMENTS IN CARPET-WEAVING MACHINERY.

From the Specification of the Inventor, John Johnson, of Troy, State of New York.

MY invention consists in a new meth-

od of operating the figuring or pile wires in looms for weaving piled fabrics, such as Brussels and tapestry carpets.

Fig. 1 is a plan, fig. 2 a front elevation, and figs. 3, 4, 5 vertical sections, taken at the lines A a, B b, C c, of fig. 1.

The same letters indicate like parts in all the figures.

My present invention relates to improvements in the method of operating the pile wires, secured to me by letters patent bearing date the 12th of March, 1850, in which the wires on each side are drawn out from under the woollen pile, and inserted in the open shed by carriers, to which the outer ends of the wires are attached, the motion back and forth being given by the said carriers, and corresponding guides near the selvages of the cloth, which has a back-and-forth movement in unison with the carriers. In the said patented method, when two half wires are used, meeting and lapping in the middle of the cloth, so soon as one range of loops has been formed, the wires must be drawn out, preparatory to the formation of another range of loops, so that the previously formed range has no support to resist the pull of the warps, except the weaving in by the picks.

The object of my invention is to double the sets of wires, so that one set shall remain in one range of loops to resist the pull on the warps during the process of forming the next range over the other wires, or sets of wires. And to this end, the nature of my invention consists in combining together on one or both sides of the loom, two sets of wire-carriers and guides, the carriers having an alternate in-and-out motion towards and from the selvedge of the cloth, for inserting the wires in the open shed, and drawing them out of the formed loops, and carriers and guides together having a back movement towards the lay or open shed, and a forward movement towards the woven cloth. And my invention also consists in giving to the guides an up-and-down motion, that the wires, which at the time of weaving must be on the same plane, may pass one another.

In the accompanying drawings I have not represented any part of the weaving-loom, and only as much of my previous invention, referred to above, as is necessary to show the connection of my present improvements.

To the breast-beam *a* of the frame of the loom are attached four standard-plates *bbb'b'*, the two inner ones *bb* near to the selvedge of the cloth to be woven, and the other two *b'b'* at the

ends of the breast-beam. On each side, from the outer to the inner plates, extend four rods *cccc*, two near the top and two near the bottom, thus forming two sets.

As both sides are mounted alike, the description of one will be sufficient. To each set of rods *cc* is fitted a plate or carriage *d*, to slide thereon freely from end to end, so that there are two such plates *dd*. In these plates are formed ways to which are fitted the carriers *ee*, each of which carries a wire *f*, and these carriers are adapted to slide back and forth in the plates or carriages *dd* the required distance to carry the figuring wires *ff* from the woven pile to the open shed and back. The figuring wires fit and slide in holes in the two guides *gg*, which are formed like the carriers, and which, like them, are fitted to slide in ways in two plates *hh* like the carriages *dd*, except, instead of being adapted to slide on the rods *cc*, they are each fitted to turn on one of the back rods. The carriers can thus be made to slide with the wires towards and from the selvedge of the cloth, the wires being sustained by passing through the guides that remain near the selvedge of the cloth, and the carriers and guides together may be made to slide towards and from the lay.

The in-and-out motion is imparted to the carriers in the same manner as in the patent before referred to; but as there are two carriers in the present plan, instead of connecting the mechanism which imparts the motion directly with the carriage of one of the carriers, the connecting-rod *i* (represented as broken off) is jointed to an auxiliary carriage *j*, adapted to slide on the lower set of rods *cc*, and it is provided with a rock-shaft *k* with two arms *ll* on one end, which, as the rock-shaft is vibrated, enter a socket *m*, first on the lower carriage and then on the upper one.

When the lower arm is in the socket of the lower carriage, the upper is out of the socket of the upper one.

In this way, by simply turning the rock-shaft part of a revolution, either of the carriages can be connected with the auxiliary carriage, so as to be moved in and out by it. The rock-shaft *k* has another arm *n*, connected by a joint-rod *o* with a rod or bar *p*, on which it can slide as the auxiliary carriage is moved in and

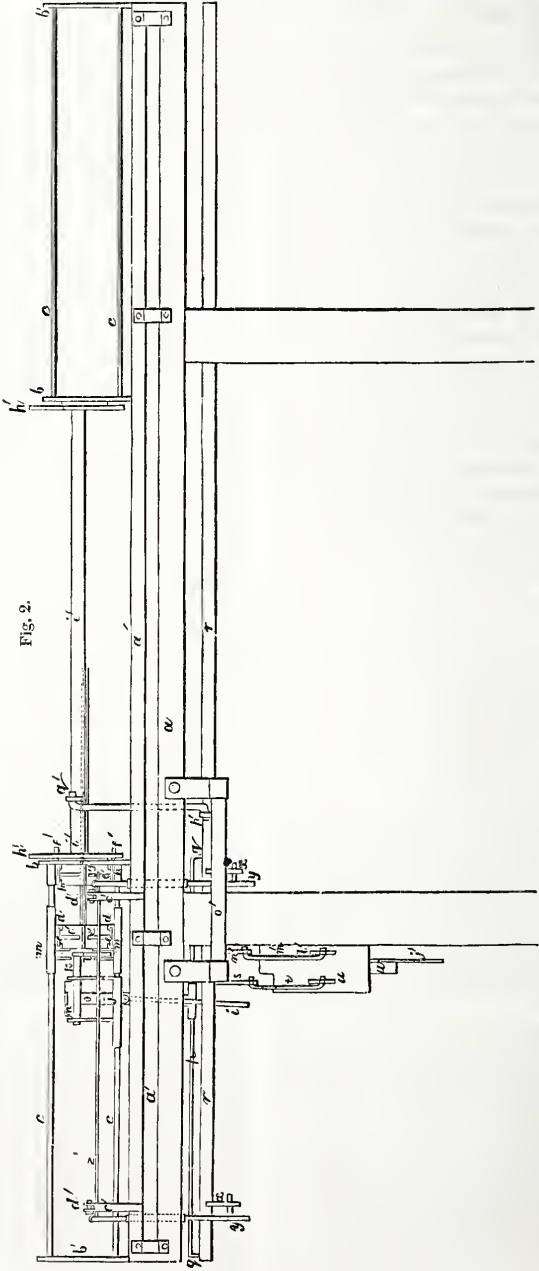
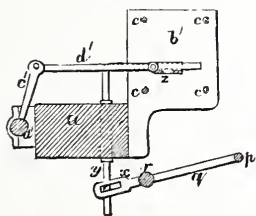


Fig. 2.

out; and the bar p is on the end of two arms $q q$ of a rock-shaft r , provided with an arm s , connected by a rod t with a slide u , which carries two pins $v v$ embracing the periphery of a cam w that receives motion from some part of the loom, so that when the slide is carried back by the cam, the auxiliary carriage is connected with the carriage of the lower carrier, and *vice versa*. The rock-shaft r , by its connection with the slide u , in addition to the function just described, also shifts the apparatus which moves the carriers and guides towards and from the lay, that the upper and lower set may be alternately operated. For this purpose the said rock-shaft r has two arms $x x$ connected with two lifters $y y$, that slide vertically in sockets fitted to the breast-beam. The upper ends of these lifters are horizontal, and to them are fitted the ends of a bar z , so that it can be made to slide thereon freely by the vibration of a rock-shaft a' provided with two arms $c' c'$, connected by rods $d' d'$ with the bar z .

Fig. 3.—Section on A a.

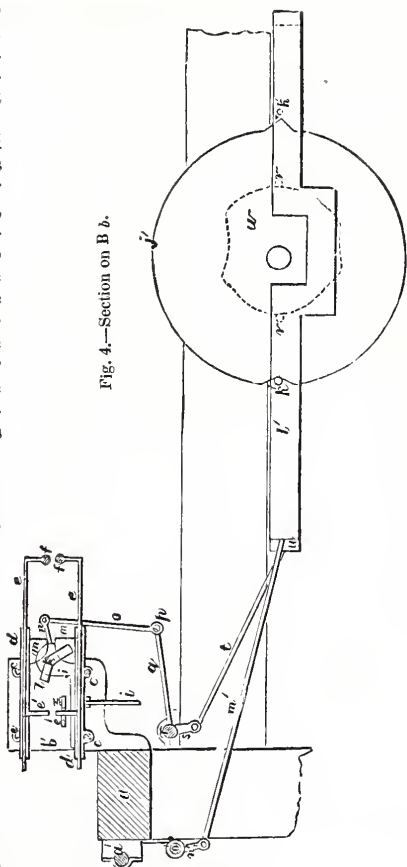


The rock-shaft a' is to be connected with and operated by a mechanism like that described in the patent referred to for moving the wire-carriers and guides towards and from the lay, and the range of motion to be given to the bar z must be sufficient to carry the wires from the woven pile to the open shed of the warps, that they may be there inserted.

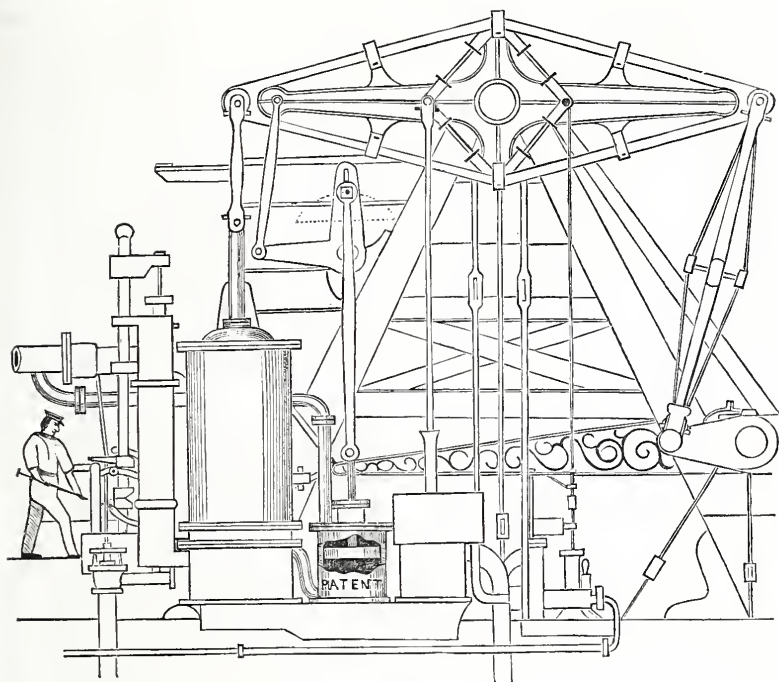
The wire-carriers and guides are each provided with a stud-pin e' , projecting upwards on the lower, and downwards on the upper set. The bar z has a slot extending nearly its whole length to receive alternately the pins e' of the two sets of carriers and guides, and in which the pin of the two carriers alternately slide as they move to and from the lay, to insert and withdraw the wires.

In view of this, the purpose of the vertical motion given to the lifters yy is to

Fig. 4.—Section on B b.



shift the bar z from the lower set of carriers and guides to the upper one, when one wire is to be drawn out of the woven pile and carried to and in the open shed to form a new range of loops, whilst the other wire remains in the woven pile, and *vice versa*. The ends of the carriers and guides are bent—the lower set up, and the upper set down. This is for the purpose of having the two wires as near as possible on the same horizontal plane. The ends of the two carriers just pass each other without touching, which brings the two wires sufficiently near to the same horizontal plane, as the carriers do not go near to the selvedge of the cloth; but as the guides are near to the selvedge, the wire there must be on



tor, whereby, without incurring objectionable irregularity of propelling force, the engine may cut off steam much earlier in the stroke than is at present practicable.

It is too generally known for comment here that steam, worked expansively, has its performance increased in varying ratio according to the period in the stroke at which it is cut off, and that the economy which ensues, by the reduced consumption of fuel, is dependent upon the degree of expansion employed, the performance of the steam, for instance, being multiplied more than three times when stopped at one-eighth of the piston's stroke.

The impediment which exists to a general adoption of a large and profitable expansion of the steam, is to be found in the irregularity of propelling force which it produces at one part of the stroke, as compared with another. In land or stationary engines, where a steady and unchanging speed of main-shaft is absolutely requisite, and consequently an equality of power throughout the stroke essential, this referred-to impediment is in a meas-

ure, to a moderate extent, by the fly-wheel overcome; but the effect of the fly is very limited, and but little scope for profitable expansion is produced by it; while in those cases where fuel is not only costly, but cumbrous, as with the marine engine, and a reduction in its consumption exhibits a multiplied economy by the diminution in expense, and additional stowage-room afforded applicable to freight, the fly-wheel, as a regulator of speed, is totally inadmissible.

The equalizer, as represented in the accompanying engraving, operates similarly to a fly in checking the inequality of force produced by expansion; but it is an arrangement at once compact, governable to any variable or required amount of effect (thereby making a larger expansion practicable), and possesses the important advantage of being equally applicable to all engines, whether on land or water. It is here shown attached to a river steamboat engine, and consists, as will be seen by reference to the engraving, of a small piston working within a

close cylinder (situated at one side of the large cylinder), the said piston being constantly exposed to the steam from the boiler on its one face, by branch connected with the main steam-pipe, and by further branch to the vacuum of the condenser on its other side, it receiving two strokes for one of the engine either way, through its attachment to a bell-crank, from which it is operated by the beam, and which motion of two strokes to one will be readily understood by viewing the dotted arc described of the arm of the bell-crank positioned vertical.

The equalizer thus constructed and arranged, will, as is evident by a little study, be caused to act as a drag for the first half of the engine-stroke either way during the pull upon it against the steam on its upper face whilst performing its up-stroke, this taking place when the steam (working expansively) is strongest, and will afterwards be made to operate as an auxiliary to the same amount of effect during its descent at the closing half of the engine-stroke, when the steam, by expansion, is weaker, it thereby taking off power from the engine when strongest, and putting on the same borrowed force when weakest, and so regulating the propelling power of the engine throughout its entire stroke. No steam or vacuum is consumed by the equalizer, there being no escape, and its alternately changing effects are so gradual, it having by the varying leverage most force at the points required, that its action is deprived of all shock, which will be apparent from the position it is here shown to occupy, being at its dead point or extremity of the up-stroke, this occurring when the engine-piston is half-stroke either way. The power of the equalizer is varied as desired to suit any change in the cut-off of the valve-geer, by altering the stroke of the equalizer piston, which effect is equivalent to increasing its diameter, the rod that operates it being attached to the connecting bell-crank by slot, and the equalizer cylinder being of suitable depth to admit of such alteration. It remains to be noticed as an important advantage, that whatever fluctuation of impelling power is felt by the engine through change in pressure of steam in the boiler, or alteration in the condition of the vacuum in the condenser, a corresponding action will take place in the equalizer,

which thus always maintains the same relative effect with the engine; also that by reason of the equalizer being exposed to the full pressure of steam in the boiler, its piston is required to be but of very small diameter, the cylinder, in size, being comparatively scarce more than a small pump-barrel: these, in points of self-adjusting effect, compactness, and consequent economy, are advantages obtained through the employment of the propelling steam, instead of vacuum alone.

Equalizers of different kinds have before been used, but I am aware of none that produce so largely the results I have endeavored to show. It is not proposed fully to equalize the propelling power of the engine throughout its entire stroke, as such is not requisite or desirable, but merely to produce a sufficient approximation to uniformity, when working expansively, as will insure regularity in speed of the main shaft, and so derive all the benefits of cutting off steam early, without any of the attendant evils. The effect of the equalizer as applied to the marine engine, would be not only to largely economize fuel, but also to dispense with the disagreeable and destructive concussion now existing and felt at the commencement of each stroke; while with land engines it would be equally advantageous, whether of the high or low pressure form, one face of the equalizer piston being exposed to the atmosphere, if the engine be of the non-condensing kind, and the equalizer, if preferred, or found more convenient, being operated from the main or second shaft, by which means it may, at a trifling cost, be attached to engines now working.

Respectfully Yours,

ALFRED GREGORY.

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WADDELL'S PATENT ESCAPE-VALVE AND GOVERNOR FOR MARINE ENGINES.

MR. R. WADDELL, chief engineer of the Atlantic steamship *Africa*, has recently patented various inventions applicable to steam-engines, amongst which are an improved form of escape-valve, to relieve the cylinders of any water which may collect in them; and a governor, to check the admission of steam to the cylinder when the engines run away, from the water leaving the paddle-wheels, or

Fig. 1.

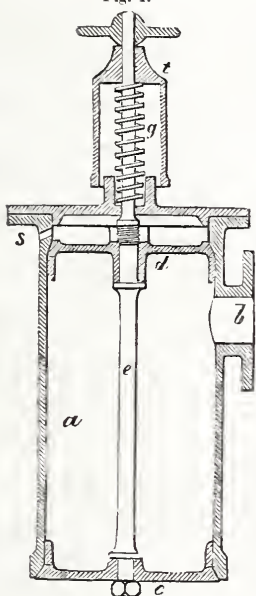
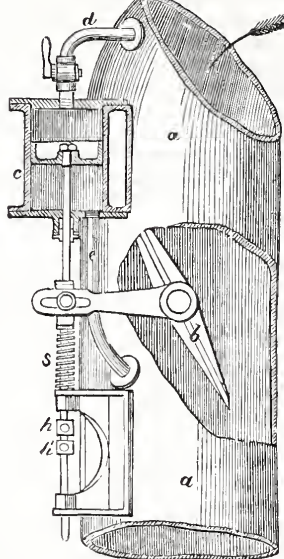


Fig. 2.



the screw. Water in the cylinders has, no doubt, been the cause of more accidents to marine engines than any thing else, and the fault of the ordinary escape-valve is, that it does not allow the water to escape until all the space for clearance is filled with water, and the strain on the engine is then severe, on account of the limited area for the escape of the water. In Mr. Waddell's escape-valve the water is drawn off gradually, and never allowed to accumulate. Its construction will be readily understood from the above diagram, fig. 1. *a* is a small cylinder, attached by the flange *b* to the lowest convenient point in the cylinder of the engine, and serving as a receiver for the water as it forms. *c* and *d* are two valves fitting on faces at either end of the cylinder, and attached to a spindle *e*. The lower valve *c* being slightly larger than the valve *d*, the steam presses with a slight (because nearly balanced) force on the lower valve, tending to open it. The spindle is therefore held up by means of the spiral spring *g*, and when the weight of the water, the valves, and this pressure, are sufficient to overcome the resistance of the spring, the valves

descend and allow the water to escape, until an equilibrium is obtained. The upper valve *d* is made like a piston to prevent any steam passing it when it is off the seat; and in case any should do so, openings, as at *s*, are provided. The spring *g* is protected by the cover *t*, which also acts as a guard to prevent the valves opening too far, and a handle is provided by which the valves may be moved by hand, to keep them in working order, or to drain the water off. This apparatus may also be attached to the steam-pipes, to keep them free of condensed steam.

Mr. Waddell also specifies another arrangement, differing from the above only in the valves being opened by the action of a float inside the cylinder, the buoyancy of which gives the desired action as the water accumulates.

The governor, represented in fig. 2, is applied to the steam-pipe to act upon the ordinary throttle-valve, or a separate valve may be fitted: *aa* is the steam-pipe, and *b* the throttle-valve; *c* is a small cylinder fitted with a piston and rod, and bolted to the steam-pipe. The ends of the cylinder are connected to the steam-pipe by the pipes *d* and *e*, one above, and

the other below the throttle-valve. When the engine runs away from the diminished resistance of the wheels or screw being out of the water, the pressure of the steam is also diminished by being wire-drawn by the throttle-valve; consequently, on the upper side of the piston we have the pressure the same as in the boiler; and on the other side the diminished pressure due to the sudden expansion of the steam. The effect of this is to depress the piston and shut off the steam from the engines by closing the throttle-valve. When the pressure becomes equal, the piston is raised, and the valve opened by the action of the spiral spring *s*. The stops *h h* on the lower end of the piston-rod can be adjusted by set-screws, to allow the throttle-valve to be acted upon to any determinate amount.—*London Artisan*.

MECHANICS FOR THE MILLION, NO. VII.

Continued from page 611.

WORK OF STEAM.

Work developed by the Condensation of Steam.

22. WHEN water is raised into steam at the boiling temperature, or 212° , its volume is increased 1711 times, or a cubic inch of water will very nearly form a cubic foot of steam. Now if steam at this temperature be allowed to enter the lower part of the cylinder (see figure to Art. 22), then the pressure beneath the piston will just counterpoise the pressure of the air upon the piston, and a small additional force will cause the piston to rise. If, then, the steam be condensed by a jet of cold water, a vacuum will be formed, and the piston will be pressed downwards with the whole weight of the atmosphere resting upon the surface of the piston. But it has been found that a perfect vacuum cannot be formed in this way, because water gives off vapor at all temperatures. Thus, at the temperature of 150° , the pressure of the vapor is 4 lbs. Now if 14.7 lbs. be taken as the mean pressure of the atmosphere, upon 1 inch of surface, we shall have, by the condensation of steam, upon an average, an effective pressure of 14.7 lbs. — 4 lbs. = 10.7 lbs. upon each inch of the piston.

Ex. 1. Required the work developed by the condensation of a cubic foot of water, supposing 4 lbs. to be the elastic-

ty of the vapor after condensation; required also the duty of the atmospheric engine using the steam in this manner.

Volume of the vacuum formed by condensation = 1710 cubic feet.

Pressure on 1 inch of the piston = $14.7 - 4 = 10.7$ lbs.

Now if we suppose the area of the piston to be 1 square foot, the length of the stroke will be 1710 feet.

$\therefore$ Work of 1 cubic foot of water = $144 \times 10.7 \times 1710 = 2634768$.

And duty or work of 1 bushel of coals = $2634768 \times 11.5 = 30$ millions.

Ex. 2. What must be the effective evaporation of the boiler of an atmospheric engine, so that the horse-powers may be 30, allowing 3 lbs. for the elasticity of the vapor in the condenser?

Here work of the engine per minute = 30×33000 .

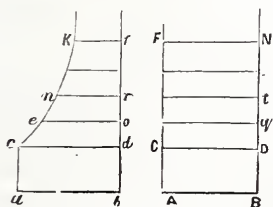
Work of 1 cubic foot of water = $(14.7 - 3) \times 144 \times 1710 = 2881008$.

$\therefore$ Number of cubic feet of water evaporated per minute = $\frac{30 \times 33000}{2881008} = 34$.

Work of Steam used Expansively.

23. When steam is used expansively, it is allowed to enter the cylinder for only a part of the stroke, and then, for the remaining portion, the piston is moved by the expansive force of the steam. This is the most economical way of employing steam-power; for all the available work is taken out of the elastic vapor before it is condensed. Now when the volume of steam, or any elastic fluid, is increased, its elasticity or pressure is decreased in the same ratio; that is, if its volume is increased two times, its pressure will be one-half of what it was at first, and so on. This is called Marriotte's law. Let the steam be cut off when the piston is at *cd*, in the accompanying drawing, and let the remaining part of the stroke be divided into any even number of parts; then the pressure of the steam upon the piston when it arrives at the different lines, forming the division, may be ascertained by the law just explained. Let *dc*, *eo*, *rn*, &c., be lines containing as many units as there are units of pressure on the piston at the corresponding points of the stroke, then the work done from *A B*

to cd will be the area of the rectangle ad , because this work is the product of the pressure cd by the space bd ; the work done from cd to fn will be represented by the units in the curved space $cdfk$, because the work done from d to q is very nearly the pressure cd multiplied by the space do , and the work done from q to t is very nearly the pressure oe multiplied by or , and so on. Now the



smaller these intervals are taken the more nearly will the areas represent the work. In order to find the area of this space, we shall employ Thomas Simpson's rule, viz.—“To the sum of the extreme ordinates, add four times the sum of the even ordinates, and two times the sum of the odd ordinates; then this sum, multiplied by one-third the common distance between the ordinates will give the area.”

In all the following calculations the pressure of the steam in the condenser is taken at 4 lbs. per square inch of the piston.

Ex. 1. In a condensing engine the length of the stroke is 5 feet, the steam is cut off at 2 feet of the stroke, the pressure of the steam in the cylinder is 48 lbs., and the elasticity of the vapor in the condenser is 4 lbs.; required the work performed upon 1 inch of the piston in 1 stroke.

Let the space through which the steam acts expansively be divided into six equal parts, then each interval will be $\frac{1}{2}$ foot, and by Marriotte's law, $cd = 48$ lbs.;

$$oe = \frac{2 \times 48}{2} = 38.4 \text{ lbs.}; nr = \frac{2 \times 48}{3} = 32$$

$$\text{lbs.}; \frac{2 \times 48}{3\frac{1}{2}} = 27.4 \text{ lbs.}; \frac{2 \times 48}{4} = 24 \text{ lbs.};$$

$$\frac{2 \times 48}{4\frac{1}{2}} = 21.3 \text{ lbs.}; \text{ and } kf = \frac{2 \times 48}{5} = 19.2$$

lbs. Then, by Simpson's rule,

Area $cdkfk$, or work done expansively

$$\text{on 1 inch of the piston in 1 stroke} = \frac{1}{3} \left\{ 48 + 19.2 + 4(38.4 + 27.4 + 21.3) + 2(32 + 24) \right\} = 87.9.$$

Work done before the steam is cut off, that is, from AB to cd , $= 48 \times 2 = 96$.

Work done against the piston by the vapor in the condenser $= 4 \times 5 = 20$.

$$\therefore \text{Total work on 1 inch of the piston} = 87.9 + 96 - 20 = 163.9.$$

Ex. 2. Required the same as in the last example, when the length of the stroke is 8 feet. *Ans.* 197.2.

This result is obtained by dividing the space of expansion into 6 equal parts.

Ex. 3. If the area of the piston, in the last example, be 2400 inches, and the number of strokes per minute 10, how many cubic feet of water will the engine raise per minute from a mine whose depth is 120 fathoms, neglecting all friction, &c.? *Ans.* 105.

Ex. 4. The area of the piston of a condensing engine is 1440 inches, the length of the stroke, including the clearance, is 5 feet, the steam is cut off at 1 foot of the cylinder, the clearance is $\frac{1}{4}$ foot, the pressure of the steam is 30 lbs., the elasticity of the vapor in the condenser is 4 lbs., the effective evaporation of the boiler is .2 cubic feet per minute, and the resistances as described in Art. 20; required the useful load and the useful horse-powers of the engine.

Here, dividing the space through which the steam acts expansively into 4 parts, and calculating the pressures by Marriotte's law, we have,

$$\text{Work done expansively on 1 inch} = \frac{1}{3} \left\{ 30 + 6 + 4(15 + 7\frac{1}{2}) + 2 \times 10 \right\} = 48.66.$$

Now the space through which the piston moves before the steam is cut off is $1 - \frac{1}{4} = \frac{3}{4}$ ft.; and for the same reason the total length of the stroke is $5 - \frac{1}{4} = 4\frac{3}{4}$ ft.

$$\therefore \text{Work done before the steam is cut off} = 30 \times \frac{3}{4} = 22.5.$$

$$\text{Total work of steam on 1 inch} = 48.66 + 22.5 = 71.16.$$

$$\therefore \text{Mean pressure of steam} = \frac{71.16}{4.75} = 14.9 \text{ lbs.}$$

But by Art. 20, the resistances = load $+\frac{1}{2}$ load $+1+4$.

Now these resistances make up the mean pressure of the steam.

$\therefore$ Load $4\frac{1}{7}$ load $+1+4=14\cdot9$; hence load $=8\cdot66$ lbs.

One cubic foot of water gives rise to 883 cubic ft. of steam at 30 lbs. pressure.

$\therefore$ Volume of steam discharged per minute $=2\times 883=176\cdot6$ feet.

Volume discharged at each stroke $=\frac{144\cdot9}{144}\times 1=10$ feet.

$\therefore$ Number of strokes of piston per minute $=\frac{176\cdot6}{10}=17\cdot66$.

Now the useful work per minute will be the continued product of the load, the area of the piston, the length of the stroke, and the number of strokes made per minute.

$$\therefore \text{Effective horse-power} = \frac{8\cdot66 \times 1440 \times 4\cdot75 \times 17\cdot66}{33000} = 31\cdot7.$$

Ex. 5. Required the horse-power, as in the last example, when the area of the piston = 2000 inches, the length of the stroke = 10 feet, the clearance being neglected, the point at which the steam is cut off = 2 feet, the pressure of the steam = 50 lbs., and the effective evaporation of the boiler = 8 feet.

Ans. Useful H. P. = 179\cdot2.

This result is obtained by dividing the space of expansion into four equal parts.

Ex. 6. What must be the useful load when the length of the stroke is 10 feet, the pressure of the steam 60 lbs., the point at which the steam is cut off $1\frac{2}{3}$ feet, and the useless resistances as given in Art. 22? *Ans. 20\cdot2 lbs.*

This result is obtained by dividing the space of expansion into four equal parts.

Ex. 7. What must be the evaporation of the boiler in the engine of *Ex. 4*, when the steam has a pressure of 48 lbs., so that the effective horse-power may be 40?

Proceeding as in *Ex. 4*, we find the load $=16\cdot5$ lbs.

$\therefore$ Effective work in 1 stroke $=16\cdot5 \times 1440 \times 4\cdot75$.

Effective work per min. $=40 \times 33000$.

$\therefore$ Number of strokes per minute $= \frac{40 \times 33000}{16\cdot5 \times 1440 \times 4\cdot75} = 11\cdot69$.

Volume of steam discharged in 1 stroke $=10$ feet.

Volume of steam discharged per minute $=10 \times 11\cdot69 = 116$ feet.

Volume of 1 cubic foot of water in the form of steam at 48 lbs. $=575$.

$\therefore$ Cubic feet of water evaporated per minute $=\frac{116}{575}=2$.

Ex. 8. Required the duty of the engine in *Ex. 4*.

Useful work per min. $=31\cdot7 \times 33000$.

Now this work is done by the evaporation of 2 feet of water.

$\therefore$ Work of 11\cdot5 feet of water, or 1 bushel of coals, $=31\cdot7 \times 33000 \times \frac{11\cdot5}{2} = 60$ millions, which is the duty of the engine.

To find the point of the Stroke at which the Steam must be cut off so as to perform the greatest amount of work.

24. When all the useful work is taken out of the steam, its pressure, at the end of the stroke, must just be equal to the pressure of the useless resistances referred to 1 inch of the piston; that is, the pressure at the end of the stroke (by Art. 20) $=1+4\frac{1}{7}$ load. The load being determined approximately, it then remains for us to find the point at which the steam must be cut off, so as to have its pressure, at the end of the stroke, equal to this quantity.

It will readily be seen, that if the pressure of the steam at the end of the stroke were greater than the sum of the useless resistances, then its expansion might be carried further, and still be doing useful work; and on the other hand, if its pressure at the end of the stroke were less than the sum of the useless resistances, then the expansion would be carried too far, for the steam would be doing less work than that which would be destroyed by the useless resistances.

In our best constructed engines, working with a crank, the clearance has been reduced to a very small fraction: hence, in calculations of this kind, this element may be neglected without incurring any sensible error.

Ex. 1. The length of the stroke = 5 feet, the pressure of the steam = 30 lbs., the useful load = 8\cdot4 lbs., and the useless resistances as described in Art. 20; required the point of the stroke at which the steam must be cut off to yield all its useful work.

Here, the useless resistances $= 1 + 1 + \frac{1}{7}$ of $8.4 = 6.2$ lbs. The pressure of the steam, therefore, at the end of the stroke, must be 6.2 lbs. Let $x =$ the point of the stroke where the steam must be cut off so as to have this pressure at the end of the stroke; then, by Mariotte's law,

$$30 \times x = 6.2 \times 5, \therefore x = 1.033 \text{ feet.}$$

Obs. In this example we have assumed the useful load, but this ought to be verified.*

Ex. 2. Required the same as in the last example, when the load is assumed to be 9.1 lbs. *Ans.* 1.05 ft.

Ex. 3. The length of the stroke $= 10$ feet, the pressure of the steam $= 40$ lbs., and the resistance of the vapor in the condenser, together with the friction of the engine, $= 5$ lbs. per square inch of the piston; required the point at which the steam must be cut off so as to yield all its available work. *Ans.* $\frac{3}{4}$ ft.

Ex. 4. The length of the stroke $= 8$ feet, the pressure of the steam $= 36$ lbs., the pressure of the vapor in the condenser $= 3$ lbs., and the total resistance of friction $= 2$ lbs. per square inch of the piston; required the same as in the last example. *Ans.* $1\frac{1}{5}$ ft.

(To be continued.)

MEN AND THINGS MECHANICAL.

For Appletons' Mechanics' Magazine.

A MAN'S judgment is too often the bond-slave of his tastes. The slavery is of very ancient origin, and successive ages have only added rivets to the chain. From the earliest known dates in Grecian and Roman history, down to our own day, we shall find that the advance of nations in what are called the *fine arts*, as distinguished from the *useful arts*, has constantly been proportionate to the greater polish or refinement to which the same nations have attained in the same time. Now, since this term, *refinement*, has become very generally used of late, and, in proportion to the generality of its use, has become extremely unsettled in its meaning, it may not be altogether useless to expose and correct at least *one* of its misapplications.

We shall be no less mistaken, because

the mistake is hard to avoid, if we suppose that the *fine arts*, so called, or their collateral and kindred branches of study, are the only appropriate or congenial objects on which a refined intelligence can exercise its powers. It is, and always has been, the error of our judgments to turn away from certain studies, as impracticable for the grasp or texture of our minds, because they are, or seem to be, foreign to our tastes. The difficulty lies not in the divergence of the general direction of our minds from the general direction of a peculiar study, but for the want of a steady and controlling power to keep our minds in their normal and proper direction, and withstand the warping and distorting effects of arbitrary taste and fancy. That a man often misdirects his faculties from a mistaken notion of what his faculties really are, is no truer, nor will it appear, on reflection, any plainer than that he often forms a mistaken notion of what his faculties really are, from his other mistaken notion that his faculties are necessarily most competent to perform what his tastes are most ready to suggest.

But we do not admit that a man must abandon the pleasures of refinement if he repudiate the tyranny of taste—we mean, of course, in the intellectual kingdom. What is this taste? It is a very fickle and unsubstantial thing, built upon the ever-shifting sand of our daily associations. But that innate principle, which seeks for, and enjoys, the society of all that is refined in nature, is not so fickle and unsubstantial. Its growth is universal, and its roots are deep. It is no fastidious plant, folding its proud leaves in certain lights, or drooping its withered petals in certain atmospheres. Its sustenance is everywhere, as its craving is unceasing. No man lives that has no principle of refinement in his mind; and nowhere can man go that he may safely say, "here is no food for me."

We come now to the matter immediately before us. Entertaining such ideas as we have expressed here, we do condemn, and denounce, and earnestly deprecate the shamefully prevalent neglect of things *mechanical*, by those who pay a willing homage to things picturesque, poetical, or philosophical. We say to these men, "You see only the bones and the flesh of mechanic art—you are

* The author first gave this method in the London Mechanics' Magazine for 1844.

ignorant of its living action, and worse than ignorant of its spiritual essence, and you call that a senseless mass which is actually an animated being." Come with me, poet, painter, philosopher—presumptuous trio who acknowledge no world beyond your horizon! Come, and let us stand together on the deck of the ocean-steamer. There is not a ripple on the water around you, but a strong breeze is blowing on your cheek, the breeze of swift and steady motion; and while you fly along as on eagle's wings, you may sit down at yonder table and record your sensations as quietly as you would in your own study! Come now with me and look down into that little room, and see how the heart of the great ship beats. See how the dusky demons ply with his fiery food the monster engine that lazily rolls himself about, and with the swinging of his arms heaves his huge home along as a child trundles his hoop. Painter, can you paint motion? Can you paint the breath and the speech of animated wood and iron? If you cannot, throw your pallet and your brushes overboard. Philosopher, can you bind this new creation with those metaphysical cobwebs wherein you now sit secure, and fancying them the limits of man's mind? If you cannot, then say with Prospero,

"I'll break my staff,
Bury it certain fathoms in the earth,
And deeper than did ever plummet sound,
I'll drown my book!"

Let us send these benighted men home "with all their gettings to get understanding;" and let us treasure up ourselves this all-important lesson. There is in this world a beauty of meaning as well as a beauty of appearance—a beauty for the mind as well as a beauty for the eye. The Creator does not always give these good gifts in conjunction. There is one glory of the star, and another glory of the flower, and another glory of the diamond, and another glory of the *machine*; and because the star, and the flower, and the diamond, are beautiful to the eye, we do not deny to them the inner and spiritual beauty which they offer to the mind. Why, then, should we deny the inner and spiritual beauty of an artificial machine, because the organic body wherewith it is clothed is rough and unsightly, be-

cause it emits no tender perfume, and reflects no brilliant ray? It is as if we should walk through a great gallery of paintings, and single out as the finest pictures those which had the gaudiest frames. Here is a picture on coarse canvas with a common frame, discolored with time and dust; let us wash away the stains, and put a gilt frame upon it, and it will stand the loveliest picture in the gallery. So is it with mechanic art; possessed of rich, intrinsic beauty, emanating from the hand of a *master*, it disdains the adulteries of outward show. Be it ours, in our day and generation, to unmask this picture, and show to the refined intellects of men what a hidden treasure they have had so long at their very doors.

This mistake, so discreditable to educated and thinking persons, but so fatally prevalent, as to the comparative congeniality of mechanical studies with the higher states of the mind, has produced a very natural but a very lamentable result in the popular estimate of the *intellectuality* of such studies, and of those engaged in prosecuting them. Because they have dealt with tangible wood and iron (albeit to these rude materials they have applied the most refined and recondite philosophy) they are regarded as plebeian in their nature and habits, mere hewers of wood and drawers of water in the intellectual Israel; and yet the hard-handed mechanic begins just where the cleanly and perfumed abstractionist stops.

We Americans may learn a lesson in this respect from our transatlantic cousins. It is much to be wished that while we are struggling to ape the aristocracy of England in her social and political systems, we would as humbly seek to imitate that pure democracy of intelligence which is to her at this day her distinguishing characteristic and her crowning glory. Not only the theoretical mechanician, but the practical engineer and mechanic, according to the perfection of their skill, can claim and receive the highest honors in her republic of mind. To-day Hyde Park in London bears witness to the truth of what we say. The Industrial Exhibition, although in the management of its details obnoxious to many objections, originated in a liberal, sensible, manly, and truly democratic valuation of the mechanical skill of Eng-

land on the part of the Government of England. To-day the tables of the English nobility are graced with the presence of such men as English princes delight to honor—men who come up, some from the quiet of the study, some from the smoke and clatter of the workshop—many whose talents have won for them a *title*, the dearest boon their country has to offer, but never better bestowed than upon these children of the marriage of intelligence with manual labor.

In our own country, the Watts and Arkwrights and Whitneys of our day, by dint of their individual power, have opened for themselves the door of wealth and reputation, and none have had the audacity to bid them stand back. But we claim the privileges and immunities of high social consideration for all inventors and all mechanicians, on the ground of the *nature of what they do*. That our mistake is now beginning to be realized, and that a counter-current of popular opinion is just setting in, is evident from the higher consideration paid to the votaries of the mechanic arts during the last few years in conventional and book-making circles. But we have only half done their work. In order to restore them to a position in the estimation of society corresponding to the eminence nature has assigned them, it is necessary that their advocates should establish their title not only in equity, but in law. We will not see them slink into public favor, tolerated on the score of "usefulness," and humbly covering their unworthy faces with their hard and discolored hands. We would fain have them enter with the garb and mien of princes, coming to occupy as of Divine Right that fair domain which human folly has so long kept closed against them. We call, then, upon all sound thinkers to come into court and sit upon this great question of right. It may take years, tens and twenties of years to decide it, but once decided, the retribution shall be as glorious as the wrong has been universal.

(To be continued.)

BETA.

ON THE APPLICATION OF ELECTRO-METALLURGY TO SCULPTURE, BAS-RELIEFS, AND OTHER PURPOSES.

THE sculptor first makes his model in clay, from which he takes a cast in plas-

ter, and this again serves as a mould, into which he pours his fused metal. This latter proceeding is attended with much trouble, and not unfrequently with great danger from a risk of explosion. The metallic cast when made is by no means perfect, as it requires much labor to finish it.

The electro-metallurgist could obtain a far more perfect cast at once, by simply preparing his plaster, black-leading it, and placing it in the solution of sulphate of copper. A wire in contact with the black-lead must communicate with the zinc of the battery, whilst the sheet of copper to be dissolved should communicate with the silver.

For very large designs, an inconveniently large vessel would be required; to obviate this difficulty, the mould, provided it be hollow, might have the separate pieces of which it is made so joined together by wax or grease that itself should form the vessel to contain the liquid. Very large batteries ought to be employed by the sculptor, and rather a dilute solution; because, in all probability, the size of the battery will not be proportionate to the immense surface exposed in even a moderately-sized design. The piece of copper forming the positive plate should be as large and as close to the plaster mould as it can be placed, in order that as little impediment as possible may be afforded to the passage of the current.

The copper may be of any thickness; and its strength and thickness may be regulated, as required in different parts, by increasing or diminishing the distance between the various parts of the plaster and the positive plate of copper. The relative cost of this method of making a bronze figure, to that of the plan now in use, is, perhaps, difficult to estimate accurately. By the old plan a bronze figure costs the value of the copper and the coals required for its fusion, besides the labor requisite to render the metal cast perfect afterwards. By the galvanic method it would cost the value of the copper, the value of an equal weight of amalgamated zinc, and the cost of the labor required to work the batteries, less the value of the sulphate of zinc formed. From the above statements, a rough idea only can be formed of the relative cost of these two methods in practice, and it

can only be determined with certainty by very large operations.

I do not know that I can give any more accurate notion of the power of electro-metallurgy, than to notice that it can copy a Barton's button with most perfect accuracy. I have an electro cast of a Barton's button in copper. The specimen is now upon my paper, and the dazzling brilliancy of the colors is so great, that it painfully distresses the eye to observe it at the reflecting angle. Perhaps it is hardly necessary to remind my readers, that the lovely colors which it presents are due to lines ruled exceedingly close together. These electro casts might doubtless be used for ornamental purposes.

In Mr. Timbs' valuable Year Book of Facts for 1847, a record is made of certain experiments performed by Professor Silliman, in which he most successfully copied the iridescent colors of mother-of-pearl, and the process of which appears to be of sufficient importance to transcribe :

"A few months ago, while engaged upon some experiments in electrotyping, I was led to think that by this process the hues of the pearl might be readily transferred to those metals which, from their hardness, are incapable of receiving impressions in mass; but yet on account of their freedom from oxidation retain for a long time a surface comparatively pure. I therefore took a Smee's battery which I had just constructed, and after several experiments succeeded in obtaining small sheets of silver radiant with the hues of the shell. When seen by a single light as that of a lamp, the play of colors is surpassingly beautiful, scarcely inferior to that of the pearl, and where equal care was employed, the plate of silver which was formed eight months ago rivals in brilliancy that which came fresh from the battery but a few hours since.

"The process by which this result is obtained is as follows:—The first thing required is to prepare the shell. This is effected by grinding and polishing it upon the back in such a manner as to cut through the numerous concentric strata that compose its substance. When this is done, by the aid of a microscope the surface will be seen covered with delicate grooves, some thousand in an inch,

formed by the sections of the concentric laminae, and this configuration gives rise to the glowing tints of the shell. The next step is to obtain an exact impression of this surface upon some good conductor of electricity. This we are enabled to do by means of fusible metals, if proper precautions are employed in taking the impression. I pursue exactly the same method as in taking the copy of a medal. After fusing the metal, I pour it upon oiled paper, and when the air-bubbles cease to rise through the metal, the oxide is skimmed from its surface with a card, and as soon as it presents the appearance of a perfect mirror the shell is forced down upon it by a sudden pressure. When the metal has cooled, I remove it from the shell, and having ascertained the accuracy of the impression, immediately plunge it before any change of the surface can occur, thereby completing the circuit between the poles of the battery. In a few moments the surface of the metal is frosted with silver, and the configuration of the shell exactly copied. A sheet of silver of sufficient thickness to be easily removed with a penknife will be deposited in the course of five or six hours under favorable circumstances."

Electro-metallurgy is now found of the utmost value to the model-maker. I have lately seen some parts of a most beautiful model which is being manufactured by Mr. James, the eminent model engineer, for the Great Exhibition. It is a perfect representation of the Menai Bridge, showing its construction, and made to scale. The tubes were deposited in parts which were afterwards soldered together and electro-silver-plated. Another model of the great suspension bridge over the Dnieper has the abutments electro-silvered so correctly to imitate stone that the eye may be easily deceived on inspecting it.

Mr. Chaterton, who executes exquisite carvings of ivory by means of a peculiar machine, exhibited last winter at the various scientific soirées a skull bust prepared by electro-metallurgy. His *modus operandi* was to form a cast of the head, and coat it with copper, and then to remove the interior cast. In the copper mould thus obtained, he deposited a copper reverse; but the whole operation is subject necessarily to considerable diffi-

culties requiring continual watching. The bust he exhibited was very perfect, but the exact means he used have not been published.

The application of electro-metallurgy, or the art of working in metals by the galvanic fluid, is not confined to the foregoing subjects; for every kind of object which can possibly be made in copper by any other method, can also be made by electricity. With regard to the use of other metals for the like purpose, they can in some instances be employed; but still, the application of the galvanic fluid to the working of these must be limited, because the intrinsic value of many is so great as to preclude their general use; whilst the value of others is so trifling as to render their application of little value.

As a general rule, all articles of tin, lead, iron, and zinc are infinitely better and far more cheaply made by the present mechanical processes than they could be by electro-metallurgy. I do not pretend to say that there may not be some particular cases in which the pure metal obtained by the latter process might be preferred to the impure metal. Pure iron might be valuable, pure zinc might be useful, but, for all manufacturing purposes, there is but little doubt that the cheapness, ease, and, above all, the capability which mechanics possess of an unlimited production of articles by the steam-engine gives a vast preponderance in its favor, especially when we consider the mind continually required to superintend and direct voltaic processes.

For articles of copper, the benefits of electro-metallurgy do not manifest themselves whenever the cost of the workmanship is not equal to the cost of the voltaic reduction, and whenever the object can be made by pure mechanical means, as the latter in these cases are mostly to be preferred to chemical means. As soon, however, as the cost of the materials and labor exceed those required by the chemical, then does electro-metallurgy begin to be advantageous, and the multiplication of all elaborate and highly finished articles should be effected by the latter process. In a former part of this work data for ascertaining the expense of the various processes, comprising electro-metallurgy, have been quite sufficiently considered. Although, however,

throughout this work the relative cost of processes has been continually discussed, let me once again strongly urge the manufacturer to pause before he introduces electro-metallurgy and substitutes it for former modes of manufacture. Excellence and economy are the only circumstances that he has to regard in a business point of view; and he has no right to consider the beauty of any particular process, or to be allured to apply electro-metallurgy for purposes not suitable to it, by the demi-magical phenomenon of an old worn-out nail and a dissolved penny-piece being capable, after a few hours' patience, to form a duplicate of a work of art which required years for its first execution.

Attempts have indeed been made to make copper tubes by electro-metallurgy, and also saucepans and similar vessels, but there is no doubt that those who practised this mode must have been ignorant of the relative expense of the processes. However, in this case, as in others, it is possible that tubes of peculiar curves might sometimes be made profitably by electro-metallurgy, and that the absence of soldering might be turned occasionally to advantage.

Amongst the extraordinary applications of electro-metallurgy which have come under my notice, I may state that it has been applied to coat the tops of wine bottles to endeavor to close them effectually from the atmosphere.

Electro-metallurgy offers means for the multiplication of polished surfaces, but its benefit is confined to particular cases, as highly burnished surfaces cannot be so perfectly multiplied, because if those surfaces are absolutely clean adhesion would take place, and if the air adheres to the originals a slight spotted appearance termed "a curd" is noticed, which would seem to be an irregularity in the thickness of the film of air. Although burnished surfaces cannot be absolutely and perfectly multiplied, yet for many practical purposes the process may be effected. The formation of duplicates of specula must be regulated by the preceding observations, for it would be requisite always to finish the duplicate by burnishing. All such delicate processes should never be attempted till experience has taught the operator how to overcome the difficulties likely to occur.

With regard to the manufacture of silver articles by electro-metallurgy, the preceding observations equally apply. The manufacture of silver spoons and forks by the present process is effected so cheaply as to leave no shadow of doubt that it is infinitely to be preferred to electro-metallurgy. Very elaborate articles of which duplicates are required, might perhaps be advantageously made by electricity, and it is almost needless again to mention that the silver might be strengthened with layers of copper, should ever such process be required. One objection to electro-metallurgy for these purposes is the necessity for the employment of pure silver.

To workers of gold electro-metallurgy promises to be occasionally of value; for, after having once procured a mould, he can obtain the most elaborate devices; but still, in buying manufactured articles of gold, the intrinsic value of this metal is so great that the workmanship forms frequently but a small part,—or otherwise electro-metallurgy might be of importance to the goldsmith.

The dentist requires for artificial teeth an exact cast of the mouth in gold, platinum, or palladium. Now the cost of the manufacture of this is so expensive, that many are prevented from availing themselves of these valuable appendages. It is absolutely necessary that the gold should fit very accurately, or else the possessor is not able to use them. Electro-metallurgy might, perhaps, be brought to aid the mechanic in this matter, but the operator must recollect that notwithstanding the scientific principles detailed in this work, considerable skill in the manipulation would be required, especially as it is necessary that the metal should be of the utmost tenacity and firmness.

Even to the surgeon, electro-metallurgy appears likely in some cases to be useful; for when he is desirous of exerting constant pressure on any part, or of confining any part in a particular position, he can make a copper instrument exactly to suit any individual case by first taking a cast in gutta percha, plaster of Paris, or, in some cases, by a piece of gummed sheeting. At present no case has occurred in my own practice where such an application of electro-metallurgy has been required; but I have seen cases of

club-foot, where, doubtless, a metallic mould might have been applied with great benefit to the patient. With regard to metallic splints, perhaps in some cases they might be used with great advantage; but as a general rule those made of the moulding tablets or of gutta percha (such as I have described in the *Medical Gazette*) are more applicable. By a proper use of splints made of these moulding tablets many cases of broken limbs have occurred where the patients have been enabled to leave their beds and enjoy the comforts of the external air within three or four days of the accident. For these purposes splints made of gutta percha or of my moulding tablets would, from their lightness, be much preferable to metallic splints, for though they may be made to take a perfect cast of the face, they yet set so firm and hard as to bear a very severe blow without accident.

To the geologist electro-metallurgy is not without its interest, for, independently of the rationale which it affords of the veins of metals embosomed in the earth, it gives the means of obtaining in copper casts of any fossil which will remain unacted upon in the metallic solution. If the solution is acid, of course it will be unsuitable for any strata containing carbonate of lime; but then, by first taking an impression in plaster, a metallic reverse can be taken from it which will be a perfect fac-simile in metal of the original. These metallic casts are preferable to any other kind of duplicate, because they occupy less bulk, are lighter, less destructible and fragile than any other material.

Mr. Poulton has lately sent me an electro cast of the eye of a dragon fly, which under the microscope exhibits perfectly all the facets common to a compound eye. This must be regarded as a very remarkable application of this ingenious manipulation.

Electro-metallurgy is now brought to such perfection, that a copper cast of tenacious metal can be made of any size or form; and it may be even painted to resemble the object it is intended to imitate. All other materials, as far as possible, should be discarded from our museums, as for nearly all purposes the copper is entitled to a decided preference.—*Smee's Electro-Metallurgy*, 3d. ed. 1851.

PAPERS READ BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

1.

"On the Proposed Railway Communication between the Atlantic and Pacific Oceans, through the British Territories of North America," by Mr. Doull.—I will advert to Mr. Asa Whitney's project for the construction of a railway from Lake Michigan to the Pacific, through the territory of the United States, which has deservedly attracted considerable attention in England. It is quite clear, that in the paper read before the Royal Geographical Society, on the 9th of June, 1851, Mr. Whitney has injured his cause in the estimation of the British public, by taking too wide a range, by claiming for his proposed line the whole of the traffic between Europe and China, and the islands of the North and South Pacific Oceans, discarding alike the existing routes by the Isthmus of Suez, the Cape of Good Hope, and Cape Horn, and by asserting that, should the Isthmus of Panama be swept from its position, and a complete union of the two seas be effected, the commerce between Europe and the rest of the world would not flow to any appreciable extent through that channel, but would be attracted to his proposed line of railway communication. Had Mr. Whitney based his project upon its own intrinsic and legitimate merits and resources, characterized it as a mere local line, or, at most, a United States line, and not designated it as the highway and the only highway of nations, it would have assumed more of a *bona fide* and practical character; and it is quite clear that Mr. Whitney could afford thus to narrow the operations of his project, as it is evident that, if a belt of land thirty miles on each side of a line of railway is colonized, and brought into profitable cultivation (which supposition is the basis upon which the success of this project rests), abundant traffic would be created to work the line, keep it in repair, and to furnish a sinking fund for reward. The project, when divested of all extraneous and adventitious circumstances, appears to be nothing more than this: there has existed for a considerable time, and there still exists, a continuous tide of emigra-

tion setting to the west, but with its frontage extending from the boundary of the British provinces on the north to the Gulf of Mexico on the south. Mr. Whitney, conceiving it desirable to reach the Pacific as soon as possible, proposes to converge the present extended frontage of location to a belt of land sixty miles in extent, and thus to accelerate the westward tendency in proportion to the frontage thus narrowed. In order to change this direction by drawing a sufficient number of settlers into this proposed sixty-mile belt, he must hold out advantages superior to those which can be obtained elsewhere. The project, so far as it has been developed, appears to be totally destitute of any systematic arrangement for the location of settlers, or for their government, civil or municipal. Nor has any thing been said about the mode in which the numerous and hostile tribes of Indians are to be disposed of. Mr. Whitney, not being an engineer, does not appear to apprehend much difficulty in running his railway across the Rocky Mountains; which he admits to be about seven thousand feet high, and so flat on the top as to preclude the possibility of a tunnel of any reasonable length. To rise 7000 feet by a gradient of 1 in 100, would require tailing out for a distance of 132 miles, or with a gradient of 1 in 50, equal to a distance of 66. But suppose that the base of the Rocky Mountains is placed upon an elevation of 1000 feet above the level of the sea, leaving 6000 feet to be overcome by an ascending gradient, which would require, at 1 in 100, a distance of 113 miles, and 1 in 50, 56½ miles. It is scarcely possible, however, to suppose the gradients of the above character could be obtained in passing this somewhat formidable mountain range, and it is highly probable that the ascent is much more abrupt than to admit of even the steepest of the above gradients to be constructed. It is unnecessary to do more than advert to the more prominent features of Mr. Whitney's plan; and that simply in order to show that there are much greater facilities for the construction of a line of railway in the territories of British North America, and to prevent the public mind of England from being led to suppose that the route through the United States is the only practicable one. The superiority

* From the Glasgow Practical Mechanic.

of the British line, not only with respect to facilities of construction, but with reference to the greater variety and the more extensive fields of productive labor which will be opened out in the various rich mineral districts passed through, is so palpable to all who have turned their attention to this important subject, as to force itself upon the attention of the American press. The *New York Tribune* of March 27, 1851, after adverting to Mr. Whitney's project, and expressing fears that it would fail of meeting that support from the Congress of the United States which its importance deserved, proceeds to state that "the route through British America is in some respects even preferable to that through our own territory. By the former, the distance from Europe to Asia is some thousand miles shorter than by the latter. Passing close to the northern shore of Lake Superior, traversing the water-shed which divides the streams flowing towards the Arctic Sea from those which have their exit southward, and crossing the Rocky Mountains at an elevation some 3000 feet less than at the south pass, the road could here be constructed with comparative cheapness, and would open upon a region abounding in valuable timber and other natural products, and admirably suited to the growth of grain and to grazing. Having its Atlantic seaport at Halifax, and its Pacific depôt near Vancouver's Island, it would inevitably draw to it the commerce of Europe, Asia, and the United States. Thus, British America, from a mere colonial dependency, would assume a controlling rank in the world. To her other nations would be tributary, and in vain would the United States attempt to be her rival, for we could never dispute with her the possession of the Asiatic commerce, or the power which that confers." The advantages of a communication from the Atlantic to the Pacific in a northern latitude, to connect the great commercial nations of the world, which are principally situated on the northern hemisphere, was early felt by several nations, and great, though unavailing, efforts have been made to discover a north-west passage through the Arctic Regions. Halifax, in Nova Scotia, will possess considerable advantages over New York, in the United States, as the

Atlantic terminus of a railway communication across the continent of America, inasmuch as a line drawn from Cape Clear, in Ireland, to New York would pass very close to Halifax, and thus the whole of the coasting distance of the sea-passage from Halifax to New York would be saved. The support of the Government to the Halifax and Quebec Railway was not rendered with that promptitude which was anticipated, considering the favorable report of its own officers, consequently the operations of the association have been delayed. But the Imperial Government has now come forward with the offer of every necessary assistance for the construction of a railway from Halifax to Quebec or Montreal, and which the colonies will be happy to accept. So far, therefore, as the present paper is concerned, the construction of this initial portion—about seven hundred miles—of the great Atlantic and Pacific Railway may be considered as amply provided for. The passage of the Rocky Mountains is doubtless a point of considerable importance, and one upon which it must be admitted there is no data for the formation of any definite plan. All authorities, however, concur in viewing this barrier as much less formidable on the British than on the United States territory. Having crossed the Rocky Mountains, either by ascending to the summit upon lateral spurs, or passing through by a tunnel, as circumstances might determine, the line would take the direction of Fraser's River, to the Pacific Ocean. Numerous and spacious harbors, with secure anchorage, and a rare combination of maritime advantages, in the vicinity of Vancouver's Island, with an abundant supply of coal, point to this locality as the site of the future capital of the West.

Mr. Asa Whitney explained at great length the steps already taken by him for inducing the States to support his plans for forming his line on the United States territory, from New York to Columbia River, and showed that, to a certain extent, he accorded with the views of Mr. Doull; as, in case of his own plan not being adopted by Congress, he was prepared to make a similar proposition for running his line on the British territory. Captain Fitz Roy, R. N., ably supported Mr. Whitney's views, demonstrating that

there was not any serious engineering difficulties to be overcome—that the reason why the plan had not been taken up warmly by the States, was entirely political, and that the slavery question materially interfered with it. Mr. Bayley raised the question of the impediments arising from snow and frost on any line of railway during the winter. Mr. Whitney's line passed from 42° to 46° of latitude, whereas the Canadian line would pass nearly at 50° . The further the line proceeded north the less obstruction there would be from snow. If there was little moisture there must be little snow, and that very light—there was more snow in a southern latitude. Single line, with 64lb. rail, 15,000 dollars per mile. Mr. Doull, in reply, remarked that emigrants going to Canada could find nothing to do, and some left for the States, where they found employment, and were soon independent. The principal intention of the paper is to draw attention to this very anomalous state of things, and to open out public works for the encouragement of emigrants from Great Britain to settle in the British territories instead of the United States.

2.

“On the Effect of the Telescopic Funnels of Steam Ships on their compasses,” by Capt. Johnson, R. N.—This communication was made in a letter to Col. Sabine, of which the following extract gives the substance: “You will perceive by the deviation tables of H. M. SS. *Ajax* and *Blenheim*, that if no heed were taken of the deviation when regulating the ship's course, the most serious consequences might be apprehended. Taking as an example the case of the *Ajax*, with the funnel *up*, running upon an easterly course at the rate of 9 knots per hour, it will be seen that in 24 hours only, if no allowance were made for deviation, the ship would be 50 miles out of the reckoning, and with the funnel *down* the error would be increased to 72 miles in the same space of time, while the case of the *Blenheim* would not be very different. In the humid and misty atmosphere, which so often prevails on the coasts of the British Isles, the fact that a ship such as the *Ajax*, if steered a compass course, but without allowing for deviation, for mid-channel between Ushant and the Liz-

ard, would, instead thereof, be running for the dangers about Ushant with the funnel *up*, and with it *down* be so far out of the proper course as to be advancing towards the rocks south of Douarnenez Bay, is, I conceive, a proper example to show the importance of attending to the effects produced on the compass, and the two conditions of the funnels of steamships. But besides the practical question, I wish you to bring under notice the following results which I obtained with reference to the effect of hollow iron cylinders upon the compass, when placed inside each other, the object being to ascertain whether the whole difference of deviation under the two conditions of these telescopic funnels was due to the difference of their elevation and depression only, or whether a portion of the said differences was attributable to the induced magnetism of the separate parts of the funnel, when lowered, acting upon each other. As it would have required more time than could be afforded to hoist the parts of these huge funnels in and out of the ship while the requisite succession of observations were made, I procured three hollow iron cylinders of smaller dimensions, their several diameters being such as to admit of one cylinder being placed inside of another, and leaving a space of about one-eighth of an inch between their surfaces. Having placed a standard compass on one of the pedestals in the observatory, and ascertained the magnetic meridian for the moment by the collimator, the largest or external iron cylinder (No. 1) was brought in, and placed to the eastward of the compass, the principal mass of the cylinder being below the level of the needle and card, and its upper end being $2\frac{1}{2}$ inches above that level. By this means a deflexion or deviation of $10^{\circ} 10'$ was produced, the north end of the needle being drawn that amount to the eastward of the correct magnetic north. Cylinder No. 2 was next placed inside of No. 1, when the deviation was increased to $12^{\circ} 15'$. Cylinder No. 3 was then placed inside of No. 2, and the deviation was again increased to $14^{\circ} 15'$, the north end of the needle being drawn to the eastward in each case. Hansteen's Magnetic Intensity Instrument was then placed with the centre of its needle (as nearly as I could adjust it) in a similar

position to that which the centre of the compass had occupied, and the following results were obtained :

	Time of 100 vibrations starting from an arc of 18°.
Previous to the cylinders being brought into the observatory..	6' 57"
No. 1 cylinder in place.....	6' 51"
No. 2 cylinder in place inside of	
No. 1.....	6' 47"
No. 3 cylinder in place inside of	
No. 2.....	6' 45"

The Intensity Instrument being removed, a dipping needle was then employed, and the following are the results of the observations :

	Mean of Readings. Dip.
Previous to the cylinders being brought into the observatory.	68° 37'
No. 1 cylinder placed to the south of the instrument.....	70° 10'
No. 2 cylinder in place inside of	
No. 1.....	70° 27'
No. 3 cylinder in place inside of	
No. 2.....	70° 37'

The conclusion to be deduced from all these observations appears to be, that to the induced magnetism of the surfaces of each cylinder acting upon each other is due a portion of the deviation; and reasoning by analogy, a similar deduction is applicable to the telescopic funnels of steam-ships."—*London Artisan*.

GLYPHOGRAPHY.

THIS process, the invention of Mr. Palmer, has been the most successful of the attempts made to apply the electrotype to the art of engraving. The principle of the invention consists in depositing copper in the grooves or engravings made in a layer of some soft substance spread on a sheet of copper, and covering the whole with a sheet of electrotype copper. The counterpart of the engraving thus produced, is used for printing from in the same manner as letter-press printers' types or wood-cuts. It may therefore be called a mode of stereotyping, with the difference that the stereotype is made directly from the drawing made by the artist. The drawing and other parts of the process is performed as follows :

A piece of ordinary copper plate, such as is used for engraving, is stained *black*

on one side, over which is spread a very thin layer of *white* opaque composition, resembling white wax both in its nature and appearance: this done, the plate is ready for use.

In order to draw properly on these plates, various points are used, which remove, wherever they are passed, a portion of the white composition, whereby the blackened surface of the plate is exposed, forming a striking contrast with the surrounding white ground, so that the artist sees his effect at once.

The drawing, being thus completed, is put into the hands of one who inspects it very carefully and minutely, to see that no part of the work has been damaged or filled in with dirt or dust; thence it is passed into a third person's hands, by whom it is brought into contact with a substance having a chemical attraction or affinity for the remaining portion of the composition thereon, whereby they are heightened *ad libitum*. Thus, by a careful manipulation, the *lights* of the drawing become thickened all over the plate equally, and the main difficulty is at once overcome; a little more, however, remains to be done. The depth of these non-printing parts of the block must be, in some degree, proportionate to their width; consequently the larger breadth of lights require to be thickened on the plate to a much greater extent, in order to produce this depth. This part of the process is purely mechanical, and easily accomplished.

It is indispensably necessary that the printing surfaces of a block, prepared for the press, should project in such relief from the block itself, as shall prevent the probability of the inking roller touching the interstices of the same whilst passing over them. This is accomplished in wood engraving by cutting out these intervening parts, which form the lights of the print, to a sufficient depth; but in glyphography, the depth of these parts is formed by the remaining portions of the white composition on the plate, analogous to the thickness or height of which must be the depth on the block, seeing that the latter is, in fact (to simplify the matter), a *cast* or *reverse* of the former. But if this composition were spread on the plate as thickly as required for this purpose, it would be impossible for the artist to put either close, fine, or free

work thereon; consequently, the thinnest possible coating is put on the plate, previously to the drawing being made, and the required thickness obtained ultimately, as described.

The plate thus prepared is again carefully inspected through a powerful lens, and closely scrutinized, to see that it is ready for the next stage of the process, which is, to place it in a trough, and submit it to the action of a galvanic battery, by means of which, copper is deposited into the indentations thereof, and, continuing to fill them up, it gradually spreads itself all over the surface of the composition, until a sufficiently thick plate of copper is obtained, which, on being separated, will be found to be a perfect cast of the drawing which formed the *clichée*.

Lastly, the metallic plate thus produced is soldered to another piece of metal, to strengthen it, and then mounted on a piece of wood, to bring it to the height of the printers' type. This completes the process, and the glyphotographic block is now ready for the press.

It should, however, have previously been stated, that if any parts of the block require to be lowered, it is done with the greatest facility in the process of mounting.

This process has not, however, come into much use as a substitute for wood engraving, in consequence of the impossibility of finding a suitable varnish for the use of the artist or engraver. It has, in fact, given way to another process, also the invention of Mr. Palmer, which is worked as follows: a copper-plate is etched by the process commonly employed by engravers, the lines being cut into the copper with a bold stroke. The lines are then bitten deeper by nitric acid. The etching is made *direct*, not *reversed*, as it is upon a plate that is to be worked at the copper-plate press. When the engraving is ready, the etching varnish through which the drawing is cut is covered with a conducting substance, and an electrotype plate is deposited upon the etching. When this is removed from the mould, it requires to be trimmed, for it is impossible to etch a plate or to lute the etching, so that all the lines shall be exactly of the same depth. To remove this, the face of the electrotype is levelled by grinding and

burnishing. The following instructions are to be carefully attended to:—

The operator must remember that he is producing a work of art for the surface press, and not for copper-plate printing. The drawing or etching should not be made with lines of equal thickness in all the tints. If it be so treated, with a *thick* line, and if the cross-hatching be kept of the same strength as the principal line, it will appear like a coarse pen-and-ink drawing. If it be treated in the above manner, with a *fine* line, and the work laid very close, it will have the appearance of one of the old etchings. The operator will, therefore, do well to remark, that it is only by a judicious mixture of bold and delicate work that beauty of style can be obtained; and as the darkest shades are generally foremost, and become gradually lighter to the distance, so the darkest or nearest tones should generally be formed by the boldest work, and gradually increase in delicacy to the offstage. Etching is a process nearly resembling drawing with a very fine pen or pencil, and should be proceeded with as follows:—Having obtained a polished copper-plate with an etching ground properly laid, proceed to put the design upon the plate. If it be a print or miniature that is being copied, a sketch or tracing of the same must be made with a black-lead pencil; it must then be traced on to the plate, remembering always, that the proof from the block will be in the same position as the etching, and that nothing must be etched or written backwards, as for the ordinary copper-plate printing.

In order to trace the object on to the plate, a piece of transfer paper must be placed, face downwards, upon the plate, and either the corners secured with a piece of wax or paste, or the paper held steadily down, if there be not much to trace; the sketch or tracing must then be placed on, and the outline gone over with an etching-needle, or a very hard black-lead pencil, one corner being removed at a time, to see that all is correctly transferred and nothing omitted, or that the outline is not too heavy and thick, in which case the tracing must be made lighter.

The subject being thus as it were sketched upon the plate, the next step is to proceed in all respects as if making a

drawing with a black-lead pencil, only working more firmly: care being also taken to slightly cut the copper. Care must also be taken not to try to form the dark touches and the *black* parts of the subject with a number of lines crossing and recrossing each other, but scrape them away entirely with the point of your penknife, or any other convenient instrument.

In commencing the etching of a view, it is usual to begin with the offscap, etching the same as neatly and as close as the nature of the printing will admit, working more firmly and boldly in every progressive tone, until the foreground be reached. In portraits, it is usual to commence with the eye; and in draperies at the top, working downwards.

Depth of tone should be sought as much from the breadth or thickness of the lines, as from laying them close together; and lightness of tint by the distance of the lines from each other, as also from their delicacy. A little Brunswick black may be employed to remove a false line, or efface any portion of the work; or a little of the superfluous ground from the side of the plate may be rubbed with a camel-hair pencil and turpentine: when this is dry, the work can be re-etched and finished at pleasure.

The transfer paper above mentioned may be prepared as follows: take some thin post or tissue paper, rub the surface well with black-lead, vermilion, red chalk, or any other coloring matter; wipe this preparation well off with a piece of clean rag, and it will be ready for use.

This last process has afforded some excellent work in the shape of maps. Amongst subjects of a more picturesque nature, executed by glyphography, we may mention Mr. George Cruikshank's well-known etchings of *The Bottle*. These are sufficient to show that the art of electrotyping engravings, though yet in its infancy, promises to be hereafter of importance in the Fine Arts.—*London Patent Journal*.

THE CULTURE AND MANUFACTURE OF FLAX.

THE subject of the culture and manufacture of flax is one, we conceive, of great and growing interest to our coun-

trymen, and, as preparatory to an interesting series of illustrated articles upon the flax manufacture, which we design to insert in the Magazine, we give the following report of the sub-committee appointed to investigate Schenck's patent system of steeping flax, made to the committee of the Royal Society for the promotion and improvement of the growth of flax in Ireland.

Your sub-committee, on the 31st July last, made a report on the results of their investigations up to that period. They do not consider it necessary, in this their final report, to copy that document at length, but will simply embody the information it contained in the more extended matter which they are now able to lay before you.

Though the committee, from their many opportunities of inquiring into as to the efficacy and advantage of the late Mr. Schenck's process, since that gentleman first brought it before the notice of the society, in 1847, were quite satisfied about it, they suspended their opinion until facts were brought forward on every point; and your sub-committee, in handing in the present report on the objections raised by some parties, will be able to convince you that they do not state a rashly-formed opinion of their own, but rather a publication of the results of experiments conducted by disinterested and competent parties.

As much of the advantage of flax culture depends on being able to economize, to the greatest extent, the crop after being grown, and to reduce the grower's trouble and hazard, whilst insuring the greatest value, your sub-committee hope that their report will prove Schenck's system to realize these desirable points, and will show that, if proper care be given to the process, something as near certainty will be attained as could be expected, and a much more steady return than by the old, slovenly, and uncertain process of watering, conducted by persons often ignorant of the commonest chemical principles, and generally attended with the loss of the seed—a most valuable part of the crop.

The doubts raised as to Schenck's process were—1st, that the yield of fibre would be less than by the ordinary mode

of steeping; 2d, that flax so prepared would be weakened; and 3d, that the linen made from it would not bleach properly.

As respects the first objection, your sub-committee are of opinion that, either by the common process or by Schenck's, the yield of fibre will be lessened if the fermentation is allowed to go too far. The uniformity of temperature insured by the latter would induce the belief that the yield of fibre should be increased. This is borne out by two experiments. In the one conducted at Lisburn, by Mr. Davison, in 1847, 112 lbs. of flax straw, after steeping and drying in the ordinary way, gave 20 lbs. of scutched fibre; and 112 lbs., steeped by Schenck's process and dried, gave 24 lbs. In another, tried this year, at Drimoleague, County Cork, from 112 lbs. of straw, the old process gave 14 lbs. 5 oz., and Schenck's, 17 lbs. 11½ oz. The increased yield in the first experiment was 20 per cent., and in the latter 23½ per cent., in favor of Schenck's method. As respects the quality of the fibre, the result was equally in favor of the latter system. In the first experiment, the flax steeped in the ordinary way spun to 96 lea yarn, and that by Schenck's system to 101 lea. In the second, the ordinary gave 60 lea, and Schenck's 70. A further experiment was communicated by Messrs. Marshall & Co., of Leeds, some flax straw grown in Holland being the material employed. What was steeped in Holland, in the usual way, gave 61 lbs. 1 oz., hackled; and two lots of the same straw, steeped by Schenck's system, in two different concerns, gave respectively 62 lbs. 4 oz. and 64 lbs. per cwt.; the value of the fibre per acre being, of the common steeped £9 8s., and of the patent steeped, averaging £10 12s.

With respect to the second objection, that the flax might be weakened, the same remark may be made, that fermentation, conducted on a systematic and scientific plan, was not likely to weaken the fibre more than the same amount by an uncertain process. And although the fibre might often be made *stronger* by the old plan, when the steeping was not carried far enough, yet, on the other hand, it was frequently over-steeped, and consequently *weakened*. In addition to the favorable report of spinners who had

produced yarn from Schenck's flax, of fair strength, the following results of experiments were laid before them:—Several samples of fibre, of full strength, steeped on the patent system, in different places: samples of threads from Messrs. Marshall & Co., of Leeds, unbleached, bleached, and dyed, made from the patent steeped flax to which reference has been made, all being of good, strong quality; a sample of 140's weft-yarn from Messrs. S. K. Mulholland & Hinds, and a sample of boiled yarn, for heavy linens, from Messrs. Dunbar, M'Master, & Co., of Gilford. All these were considered of fair average strength. It is evident to your committee that flax steeped by the patent process can be made either strong or weak, it being in the power of the operator, by increasing or decreasing the time of steeping, or by raising or lowering the temperature of the water, to make whatever quality suited the market, or would best remunerate him. They submit, that *strength* is not what will be most profitable to the grower, but that *fineness of quality, with softness*, will often remunerate him much better, and his interest will be to produce what is most in demand and highest priced. At this point the duty of the society ends; whatever will best remunerate the *grower* being what it is their duty to point out, and it is for the *spinner* to choose strong or weak, as he may require it for different customers.

As to the third objection, that the patent steeped flax might not bleach well, the samples of yarn, thread, lawn, and linen, produced at the present meeting, are sufficient evidence of its groundlessness. The following letter from an eminent bleaching firm is still further satisfactory:

“LISBURN, 28th August, 1850.

“MESSRS. S. K. MULHOLLAND AND HINDS:

“DEAR SIRS:—We have the pleasure to return, finished, the two pieces of linen made from flax steeped on Schenck's plan, which you sent us to bleach; and, during the process, we found the advantage more decided than with the lighter fabrics you sent us, some time ago. These, with other opportunities of judging, have caused us to conclude that the general introduction of Schenck's patent process would be a step in the

right direction, unless objections can be substantiated unconnected with the bleaching department of the linen trade.

"Yours, very truly,

"RICHARDSON AND CO."

Thus your sub-committee believe that all rational objections have been satisfactorily met. The general question having now been put in a favorable position, it rests with others to pursue the details more minutely; and it is hoped that they will be careful to note and make known both improvements and sources of failure, if any arise, so that the public may benefit by the results of their experience.

Having thus disposed of the subject confided to their care, your sub-committee feel called upon to take some notice of another project for preparing flax fibre, inasmuch as its promoters allege it to be superior to Schenck's steeping system. They allude to Mr. Donlan's plan of separating the fibre without steeping. They are so fully aware that the Royal Flax Improvement Society have no other object than the rendering flax culture of the greatest possible advantage, that, while they discharge their duty, on the one hand, of pointing out the successful result of experiments made with a view of testing the merits of Schenck's system, on the other, they feel called upon to lay before you what they conceive to be radical defects in Donlan's proposed plan.

It is sufficiently obvious that so simple a mode of obtaining flax fibre as its mechanical separation from the stems of the plant, must have been the earliest method adopted when this substance was first used for textile purposes. It is probable that accident first made known the fact, that, by immersing the flax-stems in water, when above a certain temperature, the fibre could be divested of impurities by the decomposition of the foreign matters, which, with the woody matter of the stem, are united to it. Up to the present day, no other means of obtaining a pure fibre have been devised. Weak acids, solutions of caustic potash and soda, soap-ley, and lime, have all been tried, but have all been found objectionable. The attempts which are on record of different revivals of the dry process fully prove that there is nothing new in Mr. Donlan's proposal. It is known that patents have been taken out at different periods for a

similar process, but they content themselves with a reference to some of the best known cases. In 1815, the Irish Linen Board adopted the dry preparation, then brought forward by Mr. Lee, and the records of that Board show that its principle was almost identical with that now proposed by Mr. Donlan. The most sanguine expectations were entertained of it. The very arguments now used in favor of Donlan's mode were then stated—viz., that a larger yield of fibre was obtained by it, that the coloring matter was discharged by the most simple means, that greater strength was obtained, and less tow produced. The result was, that, after an expenditure of £6000 in introducing the system throughout the country, the Linen Board abandoned it, in consequence of insuperable defects. In 1816, a Mr. Pollard, of Manchester, brought forward the dry preparation system, and proposed to make an article from flax which could be spun on cotton machinery. This also fell to the ground. In France and in Belgium similar trials were made, which turned out equally unsatisfactory. Your sub-committee are of opinion that the fatal defect of flax fibre, separated by the dry process, consists in the retention of the gummy and albuminous matter incorporated with the fibre. This being fermented by moisture at a moderate temperature, and decomposed by alkalies and acids, is not only useless, but absolutely pernicious if thus retained, since, in the processes of manufacture, when it necessarily undergoes the action of all these changes, it must come away. The case, therefore, as regards steeped flax and dry prepared flax, simply stands thus:—In the former state a nearly pure fibrous matter is produced, and the material is thus in the fittest state for spinning even yarn and making good linen; in the latter, along with the fibre is combined a foreign substance, which must be got rid of afterwards, to the detriment of the spun and woven products.

Although this appeared evident to the committee, when discussion was first raised relative to Donlan's invention, yet anxious to investigate it more fully, with the chance of finding something practicable in it, they proposed that he should bring over his apparatus to Belfast, when, in the presence of practical per-

sons, its merits should have the most careful and impartial consideration; and, if this should result in any thing satisfactory, the Society would give its influence freely in introducing it. This proposition was not complied with. The committee then sent your secretary to London, and forwarded some flax straw for a trial; but although there for several days, he was unable to get a sight of Mr. Donlan or of his apparatus. On leaving London, he requested Mr. J. G. Marshall, M. P., to have the kindness to investigate the matter, and that gentleman deputed his brother to undertake it. The following letter from Mr. Arthur Marshall contains his opinion:

“LEEDS, Nov. 11, 1850.

“DEAR SIR: My brother has asked me to reply to your letter about Mr. Donlan, because I have seen his process, and my brother has not seen it. We sent some straw from Patrinton, both rated and unrated. The samples I saw from each of the lots were well swingled, but at what expense I did not learn. The process appears to me tedious and expensive, as far as I could judge from the small quantity that was swingled when I was there. The unrated flax was extremely coarse, and only suitable for the purposes named at your committee meeting. I had previously advised Mr. Donlan to have some quantity swingled of the same straw, rated and unrated, and to submit the result to some flax-spinner, but I am not aware that he has done so. If he wanted to test the value of his invention, I think he cannot do better than adopt your suggestion, and bring his machinery over to Ireland. I saw quite enough to convince me that the process would not be suitable for us to adopt at Patrinton. However perfect you may make the swingling, I cannot see how it is to supersede the action of fermentation, in dividing the fibres.

“I remain, yours truly,

“ARTHUR MARSHALL.

“James MacAdam, Esq., jun.”

On receipt of this letter, Mr. Marshall was written to for permission to make it public, and he replied as follows:

“LEEDS, Nov. 25, 1850.

“DEAR SIR: In reply to your letter,

my brother and I have no objection to your communicating to the society the views we take of Mr. Donlan's mode of treating flax straw. We sent to Mr. Donlan some flax straw from Patrinton, of good average quality, part of it rated straw, and part unrated straw. I was not able to attend a meeting of gentlemen at Mr. Donlan's place, when samples of this straw were swingled, and the result published; but I called soon after, and saw the result. I also saw a small quantity swingled by one of Mr. Donlan's workpeople. The flax was certainly very fairly swingled, both that which had been rated, and the unrated straw; but I could not perceive any thing new in principle in Mr. Donlan's machinery, and the process appeared to me to be tedious and expensive. This is confirmed by Mr. Donlan's printed statement, where he estimates the cost at £4 6s. 8d. per ton of flax straw swingled; and at the rate of two tons per acre this would be £8 13s. 4d. per acre, for labor only, at a low rate of wages, 1d. per hour for men, and 0½d. per hour for women. The quality of the unrated flax was very poor, although apparently strong; but if the material was spun wet, I should doubt whether the yarn would be stronger than yarn from rated flax. Mr. Donlan's object appears to be to produce a strong, coarse article, for manufacturing into sail-cloth and other fabrics of that description. Our object at Patrinton being to produce flax of fine quality, which we consider the more profitable of the two, Mr. Donlan's plan appeared unsuitable for our purpose, and we thought no more about it. As to the plan of bleaching the flax fibre, and producing a substitute for cotton, we do not know any thing about it; but it is not a new idea, and we should expect, from the result of former experiments, that, owing to the great difference between flax and cotton fibres, however the flax may be managed, the cloth produced will still be very different from cotton cloth. It is very important, however, that the matter should be thoroughly investigated by competent judges, because the announcement of such a plan tends to unsettle the minds of parties who are disposed to erect steeping concerns. We ourselves, however, have not been deterred, by this cause, from carrying out

an extension we had begun of hot-water steeping vats at Patrington.

"I remain your obedient servant,

"ARTHUR MARSHALL.

"James MacAdam, jun., Esq."

In August, Mr. Price exhibited to the committee a collection of samples illustrating Donlan's processes. One series showed the flax fibre as separated by the dry mode, some tow from the same, and same coarse fabrics made from it. The fibre appeared coarse, harsh, and wiry, deficient in spinning quality, but very strong. It was considered value for about £30 per ton, and suitable for ropes, canvas, rick-covers, &c., especially if these fabrics were pitched or oiled, so as to prevent the action of air and moisture on the foreign matter which the fibres are combined with. The tow, valued by Mr. Price at £84 per ton, was considered worth not more than £28. The other series of samples consisted of flax fibre, partially or wholly bleached; and of thread and linen alleged to have been made from it. A considerable improvement was manifest in these specimens, evidently owing to the foreign matters having been partly got rid of by chemical means. Still, none of them appeared to possess that softness and mellowness which steeped flax, simply scutched and hackled, when of fair quality, displays. The committee were rather disposed to consider these samples as curious and interesting, than as likely to be useful, since it has long been an admitted axiom that the bleaching process cannot be so judiciously employed on the flax fibre, or even on yarn, as on the woven fabric. Many persons have experimented on the bleaching of fibre; and the committee are in possession of samples much more lustrous and silky than any Mr. Donlan has shown, but no practical end can be attained by their employment. Within the last week, some flax straw has been prepared near Belfast, part of it by steeping, and part by the dry process. The samples are before you, to show for themselves, the steeped lot being more than double the value of the other.

Having thus reviewed the products of Mr. Donlan's so-called discovery, your sub-committee would add a few notes on the paragraphs which have lately appeared in *The Morning Chronicle* in support of this project. In so doing,

they must express their decided opinion that the author of these articles is extremely ignorant of almost all the circumstances connected with the culture and manufacture of flax. In fact, this ignorance is so constantly apparent, that to take up the errors *seriatim* would require a separate report. Your committee's remarks must be therefore confined to a few of the most prominent:—1st. It is stated that Donlan's process (unlike all previous plans) is simply effected by mechanical means. Now, it is a well-known fact that Lee's process and others were effected by mechanism only. 2d. It is stated that the dry process retains all the oleaginous properties of the flax, and is therefore superior to the steeping system. The very reverse is the case, as dry-prepared flax is rough and harsh, while steeped flax is soft and mellow. 3d. It is stated that flax fibre is injured by steeping, and receives various impurities. Now, steeping is the only mode of getting the fibre *free* from the impurity which the dry process retains. 4th. By steeping, flax is deteriorated in value. As a proof of the contrary, none of Mr. Donlan's flax has been valued at more than £30 per ton, while good steeped flax averages £50, and often reaches £80 per ton. 5th. Kilndrying is named as a usual process; whereas it is well known that, except in a few localities, it is now never employed. 6th. The *shoves*, or woody refuse of the stems, are recommended for cattle, while science and practice have both proved them utterly valueless for such a purpose, and they are with difficulty made available even for manure. 7th. Saturation of the seed in a chemical solution is alleged to increase the fibrous part of the plant. So small a portion as the seed would imbibe could scarcely be expected to act sensibly on the constitution of the plant; and the husk of flax-seed is known to be impervious to liquids; so that, however its exterior might be affected, the kernel, which contains the germinating principle, would remain intact.

But all these errors sink into insignificance, compared with the calculation that 100,000 acres of dry-prepared fibre would give £2,800,000 more value of fibre than the same quantity steeped. Even granting the correctness of the allegation that double the produce of dry-

prepared flax could be obtained from the straw, it is evident that, since the former is valued by competent judges at £30 per ton, while the latter, as steeped on Schenck's system, has actually averaged nearly £60 per ton in the Belfast market, this assumed advantage is at once negatived—the value remaining almost precisely equal. And, while the latter could be applied to all the purposes of manufacture, the former could only be used for a few.

Your sub-committee do not deem it necessary to enter further into this inquiry. Sufficient evidence has been given of the entire want of solidity in the basis on which such flourishing, and, to persons ignorant of the subject, such plausible anticipations have been erected.

They will only further add, that the absence of all evidence supported by practical men, and the directly adverse testimony of the only practical person who has seen the process, should suggest the utmost caution to those whose sole means of judging are the perusal of newspaper paragraphs, or the inspection of nicely got up samples. They have entered thus fully on the subject, because they feel that the society has a two-fold duty to perform—in making its knowledge and experience available to guard the public from disappointment and loss; and in recommending the adoption of Schenck's steeping system to all who are interested in promoting the growth of flax, as having stood the test, after being subjected to a severe examination. They consider that it would be most unfortunate for the country if this more than doubtful project of Mr. Donlan should divert attention from it. While your sub-committee would most sincerely rejoice to find their unfavorable opinion of the latter incorrect, they feel it a paramount duty to issue a timely caution, both to flax-growers, and to the promoters of the scheme, that the first-named may not rely too strongly on plausible appearances, neglecting the substance while grasping at the shadow; and that the last-mentioned, in their over-sanguine anticipations, may be induced to consider more carefully the data on which they found their calculations.

(Signed) ROBERT M'KIDBIN, M.D.
JOHN PRESTON.
JAMES MACADAM, JUN.

MEMOIR OF JACOB PERKINS.

JACOB PERKINS was descended from one of the oldest families of that ancient portion of the State of Massachusetts, the county of Essex—a region of stubborn soil, but rich in its production of *men*. Matthew Perkins, his father, was a native of Ipswich, and his ancestor was one of the first settlers of that town. Matthew Perkins removed to Newburyport early in life, and here Jacob Perkins was born, July 9th, 1766. He received such education as the common schools of that day furnished, and nothing more. What they were in 1770 may be guessed. At the age of twelve he was put apprentice to a goldsmith of Newburyport, of the name of Davis. His master died three years afterwards; and Perkins, at fifteen, was left with the management of the business. This was the age of gold beads, which our grandmothers still hold in fond remembrance—and who wonders? The young goldsmith gained great reputation for the skill and honesty with which he transformed the old Portuguese *joes*, then in circulation, into these showy ornaments for the female bosom. Shoe-buckles were another article in great vogue; and Perkins, whose inventive powers had begun to expand during his apprenticeship, turned his attention to the manufacturing of them. He discovered a new method of plating, by which he could undersell the imported buckles. This was a profitable branch of business, till the revolutions of fashion drove shoe-buckles out of the market. Nothing could be done with strings, and Perkins put his head-work upon other matters. Machinery of all sorts was then in a very rude state, and a clever artisan was scarcely to be found. It was regarded as a great achievement to effect a rude copy of some imported machine. Under the old confederation, the State of Massachusetts established a mint for striking copper coin; but it was not so easy to find a mechanic equal to the task of making a die. Perkins was but twenty-one years of age when he was employed by the Government for this purpose; and the old Massachusetts cents, stamped with the Indian and the Eagle, now to be seen only in collections of curiosities, are the work of his skill. He next displayed his ingenuity in nail machinery, and at

the age of twenty-four invented a machine which cut and headed nails at one operation. This was first put in operation at Newburyport, and afterwards at Amesbury, on the Merrimac, where the manufacture of nails has been carried on for more than half a century. Perkins would have realized a great fortune from this invention, had his knowledge of the world and the tricks of trade been in any way equal to his mechanical skill. Others, however, made a great gain from his loss; and he turned his attention to various other branches of the mechanic arts, in several of which he made essential improvements, as fire-engines, hydraulic machines, &c. One of the most important of his inventions was in the engraving of bank bills. Forty years ago, counterfeiting was carried on with an audacity and a success which would seem incredible at the present time. The ease with which the clumsy engravings of the bank bills of the day were imitated, was a temptation to every knave who could scratch copper; and counterfeits flooded the country, to the serious detriment of trade. Perkins invented the stereotype check-plate, which no art of counterfeiting could match; and a security was thus given to bank paper which it had never before known. There was hardly any mechanical science in which Perkins did not exercise his inquiring and inventive spirit. The town of Newburyport enjoyed the benefit of his skill in every way in which he could contribute to the public welfare or amusement. During the war of 1812, his ingenuity was employed in constructing machinery for boring out old honeycombed cannon, and in perfecting the science of gunnery. He was a skilful pyrotechnist, and the Newburyport fireworks of that day were thought to be unrivalled in the United States. The boys, we remember, looked up to him as a second Faust or Cornelius Agrippa; and the writer of this article has not forgotten the delight and amazement with which he learned from Jacob Perkins the mystery of compounding serpents and rockets. About this time a person named Redheffer made pretensions to a discovery of the perpetual motion. He was traversing the United States with a machine exhibiting his discovery. Certain weights moved the wheels, and when they had run down, certain other weights

restored the first. The experiment seemed perfect, for the machine continued to move without cessation; and Redheffer was trumpeted to the world as the man who had solved the great problem. Perkins gave the machine an examination, and his knowledge of the powers of mechanism enabled him to perceive at once that the visible appliances were inadequate to the results. He saw that a hidden power existed somewhere, and his skilful calculations detected the corner of the machine from which it proceeded. "Pass a saw through that post," said he, "and your perpetual motion will stop." The impostor refused to put his machine to such a test; and for a sufficient reason. It was afterwards discovered that a cord passed through this post into the cellar, where an individual was stationed to restore the weights at every revolution. The studies, labors, and ingenuity of Perkins were employed on so great a variety of subjects, that the task of specifying and describing them must be left to one fully acquainted with the history of the mechanic arts in the United States. He discovered a method of softening and hardening steel at pleasure, by which the process of engraving on that metal was facilitated in a most essential degree. He instituted a series of experiments, by which he demonstrated the compressibility of water, a problem which for centuries had baffled the ingenuity of natural philosophers. In connection with this discovery, Perkins also invented the bathometer, an instrument for measuring the depth of the sea by the pressure of the water; and the pleometer, to measure a ship's rate of sailing. Perkins continued to reside in his birth-place till 1816, when he removed from Newburyport to Boston, and subsequently to Philadelphia. His attention was now occupied by steam machinery, which was beginning to acquire importance in the United States. His researches led to the invention of a new method of generating steam, by suddenly letting a small quantity of water into a heated vessel. After a short residence in Philadelphia, he removed to London, where his experiments with high-pressure steam, and other exhibitions which he gave of his inventive powers, at once brought him into general notice. His uncommon mechanical genius was

highly appreciated; and his steam-gun was for some time the wonder of the British metropolis. This gun he invented in the United States, and took out a patent for it in 1810. It attracted the notice of the British Government in 1823, and Perkins made experiments with it before the Duke of Wellington and a numerous party of officers. At a distance of 35 yards he shattered iron targets to pieces, and sent his balls through eleven planks, one inch thick each, and placed an inch apart from one another. This gun was a very ingenious piece of workmanship, and could discharge about one thousand balls per minute. Perkins continued in London during the remainder of his life. He never became rich. He lacked one quality to secure success in the world—financial thrift. Everybody but himself profited by his inventions. He was, in fact, too much in love with the excitement of the chase to look very strongly at the pecuniary value of the game.

PHOTOGRAPHS IN NATURAL COLORS.

In some experiments made by Sir John Herschel, a colored impression of the prismatic spectrum was obtained on paper stained with a vegetable juice. Mr. Robert Hunt published some accounts of the indications of color in their natural order obtained on some sensitive photographic surfaces. These were, however, exceedingly faint indications; and M. Biot and many others regarded the prospect of producing photographs in colors as the vision of enthusiasts—not likely, from the dissimilar action of the solar rays, ever to become a reality. M. Edmond Becquerel has published a process by which, on plates of metal, many of the more intense colors have been produced; but it appears to have been reserved for the nephew of the earliest student in photography, Niepce, to make the discovery of producing on the same plate by one impression of the solar rays all the colors of the chromatic scale. Of this process, called by the discoverer, M. Niepce de St. Victor, "*Heliochromy*"—sun-coloring—we have, through the kindness of Mr. Malone, had an opportunity of seeing the earliest specimens imported into this country. They are three copies

of colored engravings—a female dancer, and two male figures in fancy costumes; and every color of the original pictures is most faithfully impressed on the prepared silver tablet. The preparation of the plates still remains a secret with the inventor; and he informs Mr. Malone—to whom these pictures were given by him—that it is in many respects different from that published by him in his paper "*On the Relation which exists between the Color of certain colored Flames and the Heliographic Images colored by Light.*" Suffice it to say that the plate, when prepared, presents evidently a dark-brown, or nearly a black surface—and the image is *eaten out* in colors. We have endeavored by close examination to ascertain something of the laws producing this most remarkable effect; but it is not easy at present to perceive the relations between the colorific action of light and the associated chemical influence. The female figure has a red-silk dress, with purple trimming and white lace. The flesh-tints, the red, the purple, and the white, are well preserved in the copy. One of the male figures is remarkable for the delicacy of its delineation; here blue, red, white, and pink, are perfectly impressed. The third picture is injured in some parts; but it is, from the number of colors which it contains, the most remarkable of all. Red, blue, yellow, green, and white, are distinctly marked, and the intensity of the yellow is very striking. Such are the facts as they have been examined by us; and these results are superior to those which were given to the world when photography was first announced. We may expect shortly to see these *Heliochromes* presenting favorite scenes and chosen friends to us in all the beauty of native color.—*Athenæum*.

THE GREAT EXHIBITION.

It is the intention of the Royal Commissioners to form a museum, containing specimens and drawings of all the objects of interest in the Crystal Palace, to remain as a national record of the Exhibition. With this view they have issued circulars to the exhibitors, requesting them to co-operate with them in the design. It will be obvious that the verbal description of the objects exhibited,

which forms the catalogue, will perpetuate the Exhibition in a very imperfect way, and although diagrams and pictorial representations of the objects afford a partial remedy, they cannot be compared with specimens of the objects themselves for conveying an accurate idea of them. It therefore follows, that records of the articles exhibited can only be obtained by means of specimens of them; and it is now proposed to adopt this principle, as far as it may be practicable. Every exhibitor hitherto consulted on this subject has cordially welcomed the proposal, and has promised every assistance in carrying it into effect, by freely contributing both actual specimens and every information concerning them which may be desired. In respect of the department of raw materials, constituting the four first classes of the Exhibition, it will be desirable to collect specimens of the actual articles themselves, and exhibitors will be requested to place small duplicate specimens at the disposal of the Commissioners. But this principle, for reasons of costs, size, &c., will not apply, as a general rule, to machinery and articles of cubical bulk, such as metal manufactures, furniture, pottery, sculpture, &c. It is proposed to obtain a record of these, with the permission of the exhibitors, where it may be desirable to have it, by means either of accurate drawings or Talbotypes. Those cases where the representation of the article is preferred to the article itself, will be hereafter pointed out. As respects the remaining classes of the Exhibition, such as all kinds of woven fabrics, in cotton, wool, flax, silk, &c., all felted and laid fabrics, paperhangings, leather, &c., it is proposed to collect duplicate specimens of the articles themselves. The Commissioners intend that this collection shall be turned to the greatest public use; and they think that, when formed, it will occupy only the space of a moderate-sized room.

Among the recent arrivals from the United States are a ruling pen-lifter and a paging machine, which are considered to surpass every thing else of the kind now extant. The pen-lifter is a simple contrivance, for raising the pens used in ruling account-books, and it is calculated to do the work of six journeymen. The paging machine prints on both sides of the sheet simultaneously, and is capable

of paging twenty reams per day, whereas the machine at present in use can only print one side of the paper at one time, and accomplish but two reams per day.

At a numerously attended meeting of the Royal Commissioners, held on Tuesday the 19th instant, presided over by Prince Albert, it was resolved that the Exhibition should finally close on the 11th of October, and that no royal pageant or ceremony should be connected with that event.—*London Patent Journal*.

REVIEW.

The Field Practice of laying out Curves for Railroads. By JOHN C. TRANTWINE, Civil Engineer.

WE have heard so many inquiries from young engineers for a good work on this subject, that it is with pleasure we notice this little book by Trantwine. It contains all that is required for the field operation of projecting curves; and we can recommend it with confidence as a requisite addition to the outfit of every surveying party engaged in such duties.

We owe our acknowledgments to the author for the detection of an error in a set of tables which, for many years, we have been accustomed to use with every confidence in their absolute accuracy. We refer to Gregory's eighth edition of Hutton's Tables. Hassler's Tables are so full of typographical errors that we never could use them with any confidence, although we possessed at one time a copy corrected in Mr. Hassler's own handwriting. Some of these errors are also pointed out by Trantwine; but a table of logarithms, like Cæsar's wife, "should be above suspicion"—and such until now we had always regarded the eighth edition of Hutton's Tables.

PATENTS.

List of Patents (with claims annexed) which issued from the United States Patent Office from the 17th day of June, 1851, to the 1st of July, 1851, both inclusive.

TO JOHN B. WICKERSHAM, of New York, N. Y., for *Improvement in Iron Fences*. Patented July 1, 1851.—I claim the manner herein described, of securing the rails of iron fences, by means of sectional or divided parts, having slots therein, which are so arranged

that, when in place, they break joint with each other, the slot in one section, extending upward, and the slot in the other downward, so closing the slots as to prevent the rails, which have a loop, or dead eye, turned on each end for that purpose, from passing through or coming out.

To HENRY W. SABIN, of Canandaigua, N. Y., for *Improvement in Bedsteads*. Patented July 1, 1851.—I claim the knuckle joints for holding the rails of the bedstead together in combination with the rods—said rods being also employed to support the slate forming the bottom of the bedstead.

To JOHN P. PAINE, of Worcester, Mass., for *Improvement in Spectacle Frames*. Patented July 1, 1851.—I claim the combination of the spring and cylinder, with the temple bow and the glass frame, the whole being substantially as described.

To AARON PALMER & S. G. WILLIAMS, of Brockport, N. Y., for *Improvement in Grain Harvesters*. Patented July 1, 1851.—We claim discharging the cut stalks and heads of grain from the platform by means of the combination of the rake with the lever, and the co-operation therewith of the series of teeth on the face of the wheel, and the inclined rail rising above the curved guard of the platform.

To A. E. & DAVENPORT LAZELL, of Chicopee Falls, Mass., for *Improvement in Bread Cutters*. Patented July 1, 1851.—We claim the use of a series of knives or cutters, made in the form of eccentric circles or scrolls, with the cutting edge on the periphery, so as to represent a spiral line or curve, when combined with the bars or ribs of the bed piece, which serve to sustain the loaf, and also to guide the knives, and with the fingers or prongs which hold the loaf against the knives, whilst cutting, and also act as outside guides.

To MICHAEL MILLER, of Rochester, N. Y., for *Improvement in Pianofortes*. Patented July 1, 1851.—I claim the spring acting on the valve in combination with the weight of the key resting on the valve for the purposes described.

To DANIEL BARNUM, of the County of Philadelphia, Pa., for *Improvement in Machines for making Hat Bodies*. Patented July 1, 1851.—I claim the exhausting and suspending fan, with its casing and aperture, constructed, arranged, and operated substantially for the purpose described, in combination with the picker and chamber, perforated exhausted former, and exhaust fan, arranged substantially as described and shown, by which arrangements and combinations the several parts, or their equivalents, perform their several and combined functions in a better manner, and produce better results than has been heretofore attained, without any chamber, trunk, or tunnel, or any other means, to control the fibres after being suspended in the air by the fan, or between the fan and perforated exhaust cone, or former, substantially as described.

I also claim the combined action of the currents of air and the currents of numerous jets of hot water, in the hardening or wetting process, the currents of air performing the triple

duty of holding the fibres of the former, and of aiding the water to penetrate the hat body, and at the same time to carry the surplus water through the perforations into the exhaust, thus effectually preventing injury to the hat body, from the accumulation of the surplus water to wash it, while the wetting or hardening process is greatly facilitated, and the perfection of the work is secured; the whole process being accomplished by the combination of the several parts named, or their equivalents, for producing the currents of air and water, with the perforated former over the exhaust, in the manner and for the purposes described.

The effects of these improvements are the production of a machine combining the best means for opening fibrous materials and suspending them in the air, surrounding a perforated and exhausted former, and also of a new combination of means for hardening the fibres, and completing the process, without removing the hat or applying any pressure, preparatory to the suspension of the pressure of the air, by which means a great improvement is effected, as well in the forming of the hat and in the process of hardening as in the facility of operation, the whole being by combination of machinery heretofore unknown.

To THOMAS R. BAILEY, of Lockport, New York, for *Improvement in Lathes*. Patented July 1, 1851.—I claim controlling the poppet centre, so that it releases itself after the turning is finished, by connecting it with a sliding bar, having a weight or its equivalent attached, and carrying a ratchet, which is held by another ratchet attached to the stationary bed, the said catch having an arm attached, which is struck by part of the cutter head, after the cut is finished and released from the ratchet.

To DANIEL W. EAMES, of West Turin, New York, for *Improvement in running gear of Railroad Carriages*. Patented July 1, 1851.—I claim the employment of wheels, in any number of pairs, attached, on either side, to the truck or frame of railway vehicles, and set at any inclination to the horizon, converging to a point, in or below the rail, so that both wheels of any one pair will rest or travel on opposite sides of the upper surface of either one or the same rail.

To CHARLES ATWOOD, of Derby, Conn., for *Improvement in Wire Hooks and Eyes*. Patented July 1, 1851.—I claim, first, the addition of side springs to the common forms of hooks and eyes, substantially as set forth.

Second, I claim the small ridges, or elevations on each side of the beak of the hook, made by bending the wire of the side springs, or by other means equivalent thereto.

Third, I claim the jews-harp form, or partly circular eyelets, extended to form loops adapted to receive tape, in connection with the small elevations, to keep the tape in its proper place.

To JOHN CRUM, of Ramapo, N. Y., for *Improvements in machinery for Cutting Files*. Patented July 1, 1851.—I claim connecting the file blank to be cut with a bed, which has

a positive feed motion, substantially as described, in combination with an incidental rolling motion, depending upon the shape of the blank and the angle which the cutter forms therewith, substantially as described.

I also claim connecting the chisel with its stock by a joint, as described, by which they are rendered self-adapting.

I also claim holding the file down on to the oed, during the operation of cutting, and near to the cutter, by means of a roller or its equivalent, combined with the rolling bed; but this I only claim when the end of the file is so connected with its bed that it shall be free to move up and down, that the pressure of the roller may keep that part of the file that is being cut firmly down on to the bed.

I am aware that before the date of my invention, the cutter of file-cutting machines has been jointed to a helve or bar, but in such cases it has not been combined with a rolling bed, and therefore I do not wish to be understood as claiming, broadly, the making of the cutter with a joint, but to claim this only, under the limitations pointed out above.

I am also aware that the file blank has been made to slide, during the feeding motion, over a rolling bed, to adapt the transverse plane of the file blank to the line of the cutting edge, for cutting the different ranges of teeth, and, therefore, I do not wish to be understood as claiming, broadly, the employment of a rolling bed, but to claim such rolling bed when made to move with the file during the feeding motion from end to end, under the limitations specified.

TO LAKE F. CAVANAUGH, of Newfield, N. Y., *for Improvement in Handles of Brushes and Brooms.* Patented July 1, 1851.—I claim the lever jaws held together by the head piece of the screw, in combination with the conical end of the handle.

TO FREDERICK P. DIMPFEL, of New York, N. Y., *for Improved arrangement of the Steam-Engine.* Patented July 1, 1841. I claim the method described, of connecting the steam piston of a steam-engine with the crank thereof, by means of a piston-rod, fixed crosshead, side bars, forked connecting-rod and belts, or the equivalents thereof, these several devices being arranged and operating in such a manner that the cross-piece of the connecting-rod, which is placed transversely to the crank-shaft, shall be on opposite sides of the axial line of said shaft, at opposite extremities of the stroke of the piston.

I also claim the belts, or gimbal rings, or the equivalents thereof, arranged for the purpose of transmitting the movement of the crosshead to the connecting-rod of a steam-engine.

TO CHAUNCEY O. CROSBY, of New Haven, Conn., *for Improved Mode of Papering Pins.* Patented July 8, 1851.—I claim producing a new manufacture of pin rolls, either oblong, oval, cylindrical, square, or other shape or form (so that it combines, in effect, the common sheeted pin-paper or fillet, stuck or inserted pin-paper, or pins wound in closely between the layers, laps, or folds, of fillet

paper, with the common pin-cushion), whether the centre of the cushion is elevated or plane; that is, whether coned up or level, or whether the pins are inserted through crimps or not, and embraced by the fillet paper. The fillet, embracing the shank or barrel of the pins, while the heads of the pins are not so embraced, but open and conveniently accessible to be withdrawn for use, without unfolding, unwinding, or disturbing the pin-roll.

TO RICHARD DUDGEON, of New York, N. Y., *for Improved Portable Hydraulic Press.* Patented July 8, 1851.—I claim an hydraulic press, quite portable, in which the ram is hollow, and serves as the reservoir to supply the cylinder with water or other liquid, while the force-pump and its appendages are contained within the ram—so that by working the force-pump the ram is forced up until the liquid in such ram is exhausted, and by moving the handle of the pump down at will, it comes in contact with a rod attached to a valve in the pump piston, and the latter comes in contact with a valve in the end of the ram, opening them both, and allowing the water to return into the ram again through passages.

TO DAVID J. HAPPERSETT, of Downingtown, Pa., *for Mechanical Hooker-up.* Patented July 8, 1851.—I claim, in combination with a plate, or the equivalent thereof, for receiving the mass issuing from a rolling-mill, the friction-drums, the periphery of one of which is shaped substantially as described, and operating substantially as herein set forth, in such manner that by their action the plate or its equivalent is quickly raised and held stationary at the proper height to permit the mass upon it to be passed to the front side of the mill, and is rapidly lowered to the proper position to receive the mass issuing from the rolls.

TO HIRSCH HEINEMANN, of New York, N. Y., *for Improvement in Silk Covered Buttons.* Patented July 8, 1851.—I do not limit myself to the shape of the mould, nor to the pattern or color formed on the silk covering. Neither do I claim to be the first who has used the split shank plate and washer, as that has been used with a glass bead for ornamental purposes; but I do not know of any one who has used this plate, shank, and washer as the means for fastening a silk covered button, and at the same time secure and hide the ends of the silk cover in the hole of the mould, thereby making a durable, finished, and handsome ornamental button. Therefore, I claim the application of the plate, shank, and washer to a silk covered button for the purposes described.

TO BIRDSILL HOLLY and JOHN W. WHEELER, of Seneca Falls, N. Y., *for Improvement in Machines for grooving Timber.* Patented July 8, 1851.—We claim the method of forming grooves by circular saws and a deflecting throat in combination with suitable cutters.

TO WILLIAM JONES, of Bradford, *for Improvement in Harvesting Machines.* Patented July 8, 1851.—I claim the use of rotating cut-

ters in connection with the rotating rake and teeth, operating as described.

I also claim the novel manner of geering the horses or animal power under the machine so as to conduct the grain over them and discharge it in a straight line in the wake of the machine.

To WILLIAM KING, of New York, N. Y., for *Improvement in Cork Cutting Machines*. Patented July 8, 1851.—I do not confine myself strictly to the precise form of construction herein described, but claim to vary the same as desirable, while I produce the like results by equivalent mechanical means.

I claim the lifting block, susceptible of such adjustment with reference to the edge of the knife, while the machine is in motion, that from squares of varying sizes perfectly formed corks may be cut of the largest size each square will afford.

To SAMUEL and MORTON PENNOCK, of Kennet Square, Pa., for *Improvement in Seeding Machines*. Patented July 8, 1851.—First, we claim the employment of the oblique recessed washer, in combination with the cylindrical cap, provided with inclined wings or projections, which match with the oblique recesses of the washer, in such a manner that the pressure produced thereupon shall securely hold the cylindrical cap in the required position when adjusted to increase or diminish the size of the seed receptacles.

Second, we claim scolloping the end of the cylindrical cap of the distributing cylinder and using in connection those with clamp screws for holding the cylindrical cap in the required position.

Third, we claim the employment of the pin, or its equivalent, when used in connection with a clamp screw and interior cylindrical cap, when properly adjusted to increase or diminish the size of the seed receptacles.

Fourth, we also claim providing one of the journal pins of each depositing tube with a cog, which is made to fit an opening in the arm of the drag-bar when it shall be turned frontward nearly horizontal, for the purpose of detaching the depositing-tube from the drag-bar with facility.

Fifth, we further claim the employment of the trifurcated holding lever, in combination with the drag-bar and suspended depositing tube, for the purpose of holding the depositing tube in its proper position during the operation of forming the drill and depositing the seed, and by which said trifurcated holding lever may be disengaged from the pin when an obstruction is visible and allow the depositing tube to turn rearward when it shall have been struck, and thus save the pin from being broken, and this trifurcated holding lever we claim, or its equivalent.

Sixth, we also claim causing the depositing tube to assume its proper position after it shall have cleared the obstruction by the action of the long arm of the trifurcated holding lever, upon the cam or projection of the depositing tube, and this we claim as in the arrangement herein described.

Lastly, we claim so combining a separate

double arm with the frontward end of each drag-bar, that it may be detached therefrom, as well as from the eyes or loops of the front transverse beam of the frame.

To PARRY W. PORTER, of Memphis, Tenn., for *Improvement in Revolving Breech Firearms*. Patented July 8, 1851.—First, in combination with a cocking lever, I claim the two triggers, arranged and operating in such manner that the tripping of the hammer can be effected either in the ordinary manner, by pulling a trigger, or by the return movement of the cocking lever.

Second, I claim the combination of the sliding bolt with the cap-primer, the two being so arranged that, as the hammer is tripped, by pulling the trigger, a cap is applied to one of the nipples of the chambered breech, by which means the chambers are revolved by the back motion of the cock, and capped by its forward motion, the capping by this arrangement being effected in one half the time in which it can be done by other means heretofore devised.

Third, I claim the construction of the cap and bullet passages, the powder magazine and the exterior case in such a manner that the bullet and cap passages, and the included powder chamber, can be withdrawn from the exterior case which incloses them to give free access to every part of said passages and to facilitate the removal of obstructions therefrom.

Fourth, in combination with a revolving disk breech, I claim a spring powder charger, constructed and operated by the movement of the breech.

Fifth, in combination with a revolving chamber breech, I claim the stationary cap stripper, constructed and operating as set forth.

Sixth, in combination with a revolving breech firearm, I claim the spring dust plate, which permits the escape of smoke, but prevents the entrance of dirt.

Seventh, I claim the forward inclination of the spout of the bullet passage in connection with a turning breech, the two being so arranged that when the latter is turning, the bullet dropped into the chamber, is pressed against the inclined portion of the spout, and is by it forced down in the chamber of the breech, the inclined surface of the spout thus performing the office of a rammer.

To WILLIAM T. RUDD, of Amsterdam, Va., for *Improved apparatus for punching designs in sheet metal*. Patented July 8, 1851.—I claim the leather bed or die, in combination with a set of punches for punctuating purposes, when such set of punches and the die are used in connection with proper rollers.

To WILLIAM H. SEYMOUR, of Brookport, N. Y., for *Improvement in Rakes to Harvesting Machines*. Patented July 8, 1851.—I claim the rake attached for raking the grain from the machine without hand labor.

To JOHN STEARNS, of Templeton, Mass., for *Improvement in Machines for Pressing Hats*. Patented July 8, 1851.—I claim the method of alternately lowering the pressing irons upon the hat block and raising them therefrom by

mechanism, operating substantially as herein described, which is readily controlled by the attendant.

To JAMES ST. JOHN, of New York, N. Y., for *Improvement in Lifting Jacks*. Patented July 8, 1851.—I claim the catch or button, operated by the index bar, for the purpose of directing the action of the lever.

To JOHN BOARDMAN, of Little Valley, N. Y., for *Improvement in Washing Machines*. Patented July 15, 1851.—I claim the peculiar form of the revolving barrel, with its fluted semi-cylindrical recesses, in combination with a pounding frame constructed with a weighted hub and three parallel pounders.

To JAMES M. BUTTUM, of New York, N. Y., for *Improvement in securing Pinions, &c., of Watches in Lathes*. Patented July 15, 1851.—I claim the employment of adhesive cement for securing staffs and pinions of watches or time-pieces for lathe operation, in combination with a chuck, and a sliding-tube, and a female centre, or in any manner substantially the same.

To EDWIN K. BROWNING, of Utica, N. Y., for *Improvements in Machines for cutting Wood into Shreds and crimping them, for Mattress Stuffing, &c.* Patented July 15, 1851.—I claim the use of the splitters with the plane-iron and the holder, and the movable weighted lid, or any thing which is substantially the same, combined and arranged in the plane-stock F, for the purpose of producing the article herein described.

To STILLMAN A. CLEMENS, of Springfield, Mass., for *Improvement in Machines for dressing Sisal, Hemp, &c.* Patented July 15, 1851.—I claim the hinged jaw connected with the driving-shaft, substantially as described, in combination with the cylinder to which it is

manufacturing fancy stationery, for improvements in ornamenting paper and other fabrics. July 31; six months.

Charles Perley, of the city of New York, United States of America, machinist, for certain new and useful improvements in the construction of capstans for nautical and general purposes. July 31; six months.

Edward de Mornay, of Mark-lane, London, gentleman, for improvements in machinery for crushing sugar-canes, and in apparatus for evaporating saccharine fluids. August 5; six months.

Levi Bissell, of the City, County, and State of New York, in the United States of America, engineer, for certain new and useful improvements in the means of sustaining travelling carriages and other vehicles, which improvements are applicable to other like purposes. August 5; six months.

Edwin Deely and Richard Mountford Deely, of Andman Bank, Stafford, flint and bottle-glass manufacturer, for certain improvements in the construction of furnaces for the manufacture of glass. August 6; six months.

Robert Hyde Greg, of Manchester, manufacturer and merchant, and David Bowlas, of Beddish, Lancaster, manufacturer, for certain improvements in machinery or apparatus for manufacturing weavers' beads or harness. August 7; six months.

Lockington St. Lawrence Bunn, of Walbrook, London, merchant, for improvements in the manufacture of kamptulicon. August 7; six months.

Alphonse Rene le Moire de Normandy, of Judd-street, Middlesex, gentleman, and Richard Fell, of the City-road, in the same county, engineer, for improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid. August 7; six months.

Jonathan Grindrod, of Birkenhead, Chester, consulting engineer, for an improvement in the machinery for communicating motion from steam-engines or other motive-power, and in the construction of rudders for vessels. August 14; six months.

John Plant, of Beswick, Manchester, manufacturer, for certain improvements in the manufacture of textile fabrics. August 14; six months.

Thomas Skinner, of Sheffield, for improvements in producing ornamental surfaces on metal and other materials. August 14; six months.

Stephen Moulton, of Bradford, Wilts, India-rubber manufacturer, for certain improvements in the preparation of gutta percha and caoutchouc, and in the application thereof. August 14; six months.

Aime Nicolas Derode, of No. 37 Rue St. Roch, Paris, France, gentleman, for a certain process for uniting cast-iron to cast-iron and other metals, and for uniting other metals together. August 14; six months.

Joseph Birkbeck Blundell, of New-cross-road, Kent, gentleman, for improvements in machinery for sweeping and cleansing roads and ways. August 14; six months.

Henry Glynn, of Bruton-street, Berkeley-square, gentleman, and Rudolph Appel, of Gerrard-street, Soho, annastatic printer, both in Middlesex, for improvements in the manufacture or treatment of paper or fabrics, to prevent copies or impressions being taken of any writing or printing thereon. August 14; six months.

Lot Faulkner, of Cheadle, Chester, machinist, for certain improvements in the method of obtaining and applying motive-power. August 21; six months.

James Robertson, of Oxford-street, Manchester, chemist, for improved methods of producing or obtaining printing dyes and other substances used in printing; which improvements, in whole or in part, are applicable to other like useful purposes. August 21; six months.

John Walters, of Sheffield, York, Manufacturer, for certain improvements in knives and forks. August 21; six months.

List of English Patents issued from July 28th to August 28th, 1851, both inclusive.

James Timmins Chance, of Birmingham, gentleman, for improvements in the manufacture of glass. (Being a communication.) July 28; six months.

Richard Lloyd, of Paris, in the republic of France, engineer, for improvements in steam-engines and in treating steam. (Being a communication.) July 28; six months.

Peter Robert Drummond, of Perth, for improvements in churns. July 29; six months.

John Workman, of Stamford-hill, Middlesex, firmit and furnace-builder, for improvements in the manufacture of bricks, tiles, and other articles made of like materials. July 31; six months.

Charles Barlow, of Chancery-lane, London, for improvements in saws. (Being a communication.) July 31; six months.

Victor Lemoign, of Cette, Departement de l'Herault, France, for certain improvements in rotary and other engines. July 31; six months.

Charles Cowper, of 20, Southampton-buildings, Chancery-lane, Middlesex, for improvements in locomotive-engines, and boilers, and carriages, part of which improvements are applicable to other similar purposes. (Being a communication.) July 31; six months.

James Whitelaw, of Johnstone, Renfrew, North Britain, engineer, for certain improvements in steam-engines. July 31; six months.

Joseph Mansell, of Red Lion-square, Middlesex,

John Treasahar Jeffree, of Blackwall, engineer, for an improved apparatus for facilitating the more perfect combustion of fuel, whereby funnels in steam-vessels and chimneys, or shafts for factories, may be dispensed with. August 21; six months.

James Palmer, of Paddington, Middlesex, artist, for improvements in delineating objects, and in apparatus and materials for that purpose. August 23; six months.

Edward Clarence Shepard, of Duke-street, Westminster, gentleman, for improvements in obtaining and applying motive-power. (Being a communication.) August 28; six months.

Thomas Brown Jordan, of Lambeth, Surrey, engineer, for improvements in machinery or apparatus for cutting, dressing, planing, and otherwise working slate, and also for framing and setting the same. August 28; six months.

James Edward McConnell, of Wolverton, Buckingham, engineer, for certain improvements in locomotive steam-engines and railway axles, parts of which are applicable to stationary and marine steam-engines. August 28; six months.

William Johnson, of Millbank, Westminster, gentleman, for improvements in ascertaining the weight of goods. August 28; six months.

Pierre Armande Lecomte de Fontainemoreau, of South-street, Finsbury, Middlesex, and Boulevard Poissonnière, Paris, France, for certain improvements in apparatus for gas-lighting. (Being a communication.) August 28; six months.

List of Scotch Patents, issued from June 22d to August 22d, 1851, inclusive.

John Swiudells, of Manchester, Lancaster, manufacturing chemist, for certain improvements in obtaining products from ores and other matters containing metals, and in the preparation and application of such products for the purposes of bleaching, printing, dyeing, and color-making. June 25; four months.

John Emmanuel Lightfoot, of Broad-oak, Accrington, Lancaster, calico-printer, and James Higgin, of Cobourg-terrace, Stratford-road, in the same county, chemist, for improvements in treating and preparing certain coloring matters, to be used in dyeing and printing. June 26; six months.

Robert Hays, Easum, of Commercial-road, Stepney, Middlesex, rope-maker, for improvements in the manufacture of rope. July 1; six months.

George Frederick Muntz, the younger, of Birmingham, Warwick, gentleman, for improvements in furnaces applicable to the melting of metals for making brass, yellow metal, and other compound metals. July 2; six months.

Thomas Allan, of Edinburgh, gentleman, for certain improvements in electric telegraphs, and in apparatus connected therewith. July 2; six months.

Thomas Hawkins, of Inverness-terrace, Bishops-road, Bayswater, Middlesex, oilman, for improvements in brushes. July 16; six months.

John Brazil, of Manchester, Lancaster, gentleman, for certain improvements in dyeing, and in the preparation of dyewoods. July 21; six months.

John Platt, of Oldham, Lancaster, engineer, and Richard Burch, of Heywood, in the same county, manager, for certain improvements in looms for weaving. July 21; six months.

Percival Moses Parsons, of Robert-street, Adelphi, Middlesex, civil engineer, for improvements in cranes, capable of being used on railways, and in parts of railways. July 21; six months.

William Johnson, of Lincoln's-inn Fields, Middlesex, civil engineer, for improvements in machinery or apparatus for the manufacture of envelopes. (Being a communication.) July 23; six months.

Daniel Towers Shears, of Bankside, Southwark, copper merchant, for certain improvements in the manufacture and refining of sugar. July 25; six months.

Alexander Alliott, of Lenton, Nottingham, engineer, for improvements in cleaning, dyeing, and drying machines, and in machinery to be used in sugar, soap, metal, and color manufacturing. July 31; six months.

John Davie Morries Stirling, of Black-grange, North Britain, Esq., for improvements in the manufacture of metallic sheets, and in coating metals and alloys of metals in metallic compounds, and in welding. July 31; six months.

James Whitelaw, of Johnstone, Renfrew, North Britain, engineer, for certain improvements in steam-engines. August 1; six months.

Charles Cowper, of 20, Southampton-buildings, Chancery-lane, Middlesex, for certain improvements in piling, fagoting, and forging iron and steel for plates, bars, shaft-axles, tyres, cannons, anchors, and other similar purposes. (Being a communication.) August 6; six months.

Peter Robert Drummond, of Perth, for improvements in churns. August 6; six months.

Robert Oxland and John Oxland, both of Plymouth, chemists, for improvements in the manufacture and refining of sugar. August 6; six months.

James Buchanan Mirrlees, of Glasgow, Lanark, North Britain, engineer, for certain improvements in machinery, apparatus, or means for the manufacture or production of sugar. August 8; six months.

Joseph Mansell, of Red Lion-square, Middlesex, manufacturing fancy stationer, for improvements in ornamenting paper and other fabrics. August 8; six months.

William Onions, of Southwark, Surrey, engineer, for improvements in the manufacture of certain parts of machinery used in spinning. August 11; four months.

Alphonse René le Mire de Normandy, of Judd-street, Middlesex, gentleman, and Richard Fell, of the City road, in the same county, engineer, for improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid. August 13; six months.

David Farrer Bower, of Hunslet, Leeds, manufacturing chemist, for certain improvements in preparing, rating, otherwise called rotting and fermenting flax, line, grasses, and other fibrous vegetable substances. August 20; six months.

NOTICES AND CORRESPONDENCE.

FAIR OF THE AMERICAN INSTITUTE.—It might be thought very proper that a periodical devoted to the mechanic arts should contain some notice, at this season, of the exhibition of mechanical industry, now about closing, at Castle Garden; and so indeed it would, were there any thing calling for special notice.

We received an invitation to visit the exhibition during the season, of which we availed ourselves very frequently, and saw a great deal to admire in all the branches of industry there represented. The arrangements were judicious and commendable, and without doubt served the purpose for which they were intended—a stereotype of last year's exhibition to a letter, and a good advertisement for all who contributed. Further than this, we failed to perceive any thing serving to mark the exhibition as an improvement on previous exhibitions. In short, either the medals of the Institute confer little credit, or our mechanics cannot be spurred to a vigorous, healthful emulation. We know the latter not to be the case, and hence are led to infer that something is wrong in the system of awards conferred by the Institute.

The Fair was not a thing for the New York mechanics to be proud of. We have seen many a county cattle-show in New England which, for all that makes such an exhibition of value, was in advance of it—a rivalry, life and emulation, a spirit which went home with the exhibitors, and the fruits of which were to be seen in the workshops and in succeeding exhibitions. Here every thing wore a look of utter stagnation; and—beyond the reference made by successful exhibitors in their succeeding advertisements to the medals they have received—the whole thing will be forgotten in a week, and many of the articles laid by on shelves to be used again.

Premiums are duly declared, *as usual*, to the transcendental geniuses who have distinguished themselves in the preparation of bed-quilts, fancy soaps, and Daguerreotypes; and the Fair of the American Institute, ends in the *Farce* of the American Institute.

NEW YORK, Oct. 6th, 1851.

MR. EDITOR:

SIR—I see, in your last number, a few remarks upon Mr. Barnum's Fire Annihilator. The press has universally spoken of it as a great discovery—you being the first, so far as I know, to presume to question Mr. Barnum's Annihilator's virtues, or his belief in them, and without offering any argument whatever; but content yourself with slurring over things whose value you are ignorant of: for, as one interested, I demand to know upon what ground you stigmatize an invention second to none in this age, as ranking with Fejee mermaids and such humbugs.

We ask the indulgence of our readers for inserting the above elegant extract; but as it affords a good text for a few remarks on this subject, we have beaded our article with it, referring to it, however, only so far as to notice the fact which he asserts—*of the universal good opinion expressed of this Annihilator by the public press in general*—which is the more remarkable as the manager's reputation is undeniably of that order which would of itself lead to distrust of any thing of a marvellous character presented by him to the public—much more when the miraculous predominates to such an extent. We leave the solution of this anomaly to the curious in such matters.

This is by no means a new affair of the Fire Annihilator. More than six years since we heard of Phillips's experiments or exhibitions in London, where he was endeavoring to obtain aid for the purpose of securing the patent in this country, but unsuccessfully until within a few months past. These exhibitions were conducted with great skill and boldness. A temporary house was built, set in flames, and extinguished by the application of the Annihilator. Crowds witnessed these exhibitions, and departed without so much as dreaming of the trick which had been played before their eyes. These exhibitions are still continued by Phillips, and have been for several years, at intervals of about a month, in an old, disused fire-proof retort-house of the London Gas-Works, near Vauxhall Gardens, where some of our readers may have seen them during their visit to the Great Exhibition. The machines may be bought at the depot of the Company, No. 105 Leadenhall-street, London—where the

"American manager" or any one else may have bought any number they wished; but instead of this (and we appeal to the bumau sympathies of the aforesaid "manager" for relief in this matter), we have been waiting now for several months, exposed to one of the greatest scourges to which man in his fallen state is liable, and yet a specific exists; cheap, easily manufactured, and suffers no change in its virtue by "climate or time." How, we ask, can the "American manager" reconcile it with his conscience to keep us thus in ignorance of the true virtues, by experiment, of this specific?

If the reader will refer to the first volume of Appleton's Dictionary of Machines, published in this city more than a year since, article "Fire Annihilator," he will see the drawing and description of this machine, with the ingredients used in it; and be will at once come to the conclusion that there are other reasons than the one alleged in the advertisement of the Company for their delay in furnishing the machines.

Has there not been time to build a temporary shed, and, using an imported machine—*of which there are many in the country*—show to the credulous, if to none other, the astonishing effects of the Annihilator? We were told at the office of the Company that in "about a month there would be an exhibition somewhere in the neighborhood of this city." Why this delay? Why any special preparation of *imitation* burning houses? We have the real thing every night, and of dimensions to suit. Have we not fires small enough for the showing off of a "very little one" up to his highest figure? Can any one believe that there is good fire-extinguishing virtue in these machines, and yet that it requires a house to be prepared *expressly* for the exhibition of this virtue?

A machine built under Phillips's direction has been tried in this country, and failed. Straightway the "American manager" comes out in a card and repudiates the machine; alleging that the right to use it had not been disposed of by him for that State in which it had been found wanting; and disclaims any responsibility for the action of machines not made at the Novelty Works. This subterfuge will not answer, Mr. Manager. As a chemist and mechanic, at all events as a builder of *Fire Annihilators*, Mr. Phillips must be entitled to as much of the public confidence as either the "American manager" or the Novelty Works. We should rely on one of *his* machines as soon as on any of yours. You assert that Phillips's Fire Annihilator, by the generation of carbonic acid and other gases, will instantly extinguish the flames of a burning house; and also that the vapors which put out the fire may be breathed with impunity. We deny the truth of both of these statements, and challenge you to the proof. The action of your machine is no novelty to us, but in order to a convincing exposé of the charlatanism practised in the exhibition by Phillips (and by which means alone, or something similar, you can hope to practise upon the credulity of the public), we shall reserve our proof of the utter inefficiency of the machine until after the first exhibition of the action of it in this city; and in *humanity's* name, Mr. Manager, let it be at an early day.

Read the harrowing accounts in your own circular, such as this on page 4:

Let us point to the blackened logs met every now and then drifting to and fro upon the billowy Atlantic, all of which once wooed the winds with their white arms, and proudly danced along the death-route, ringing with the music-tones of joy and revelry.

And this is not all. Let us glance at the ship, solitary and alone, upon her foam-path on the ocean. Let us look at the steamer, cleaving her way over seas and lakes, with hundreds of human beings in her grasp, and the fire-fiend carefully watching, night and day, for a moment's inattention, in order to sweep the whole into an agonizing and inevitable grave! Let us look at the flame-tongues licking up, with an unearthly roar, every vestige of life and beauty—and hearken to the piteous cries of the helpless, as they are tauntingly mocked by the wind-echoes, or copied in the far-off shrieks of the frightened sea-bird!

Where are your bowels, Mr. Manager, that you could have penned such an article, and yet delay the advent of "them 'ere philanthropic little coal-scuttles?"

Please advise us of the time and place of the experiment, and we pledge ourselves to lay your machine in the grave, with Joice Heth and other distinguished worthies who have appeared under the same auspices.

To the peddler in patent rights we have one word. If this be a humbug, it is not a harmless one, like Payne's light, Gwynne's pump, or Sawyer's motive-power—but one, perchance, involving a loss of life as well as property: and we should say, look well to it; for if our opinion of it prove correct, all the blazes ever witnessed by the Annihilators combined, will be but a feeble glimmer to the blaze you will be called upon to encounter.

"J. C. S." is advised that the usual practice, in this neighborhood, is to introduce the "bow-string girder." The bow or rib of the girder of cast-iron, and of a T-section, having a rise of about one and a half feet to two feet in the centre, in a length of from twenty-five to thirty feet. The rib is cast in one piece, and a wrought-iron tie-rod shrunk in between the feet of the rib, forming the string to the bow.

We have witnessed with surprise the almost universal application of this girder, and but that the castings are usually enormously heavy, we should have heard more of them ere this; and it is highly probable that some disaster will yet grow out of their use.

We conceive the great defect of these beams to

consist in the unequal action of the two parts, producing at least an uncertainty in the action of the tie. If the tie be shrunk in "short," the rib, as well as the tie itself, is subjected to a depreciating strain. If the tie be put in slack, the cast-iron must yield to fracture before communicating any strain to the tie; and in any event they cannot, from the nature of things, be brought to act together efficiently, nor can their absolute strength be calculated with precision.

The best form of girder, in our opinion, is the one lately devised by Mr. Bogardus, of the firm of Bogardus & Hoppen, Centre-street, which they have taken measures to secure by a patent. It consists in forming the girder of two separate castings, meeting at the centre against a wrought-iron bearing-block, as in the figure. It will be perceived that the tie in this case need not be shrunk in, but simply dropped into place.

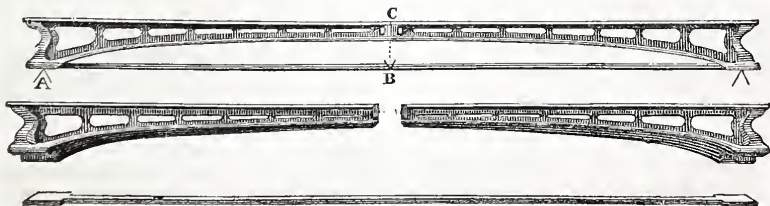
The advantages of this method are the lightness and convenience of handling the castings, their consequent economy, and the almost absolute certainty with which the strength of the girder may be calculated: for in this case the tension of the tie-rod may be taken as the strain on the beam, and may be estimated with certainty. One lately built by Mr. Bogardus, of twenty feet between the bearings, with a rise of one foot at the centre, bore without yielding or sensible derangement, the equivalent to a weight of 85,000 lbs. distributed over the girder.

The rule for ascertaining the strain on this girder will be, for the tension on the tie-rod, $T = \frac{Wl}{4r}$. Or,

the strain to which this tie is subjected will be found by multiplying the load in the centre by the clear span, in feet or inches, of the girder, divided by four times the rise in the centre, in the same unit of measure. Or, $2AB \times \text{weight at C, divided by } 4B^2C$, = strain on the tie-rod.

STEAMERS PIONEER AND CITY OF PITTSBURG.—We have in preparation, on a large scale, the drawings of the engines of these steamers, lately completed at the West Point Foundry. They are of the description known as Trunk-engines, and are the first that have been constructed in this country on such a scale, if indeed there has been any thing like them abroad.

The whole arrangement and construction reflect great credit upon the projectors and constructors—and are an additional evidence, if any were wanting, that in engine-building we are at this day, to say the least, *behind* no other nation.



"G. T." *Litchfield, Conn.*—Your plan has no novelty in it, having been long since tried; but like all feathering paddle-wheels, is in practice attended with inconveniences more than counterbalancing any presumed advantages. Again, the loss by the oblique action of the radial paddle is much overrated. If you will take into consideration the progressive movement of the vessel, you will perceive that the radial paddle by no means presents the resistance, either to entering or leaving the water, which many imagine.

"S."—The short method of multiplication proposed by you goes no further than to omit writing one of the factors when the figure 1 occurs in the other factor—a means much more likely, in our opinion, to give rise to mistakes, than productive of saving in time. In the solution of problems the calculations, properly so called, need only exercise the mind; the arithmetical operations which follow should be nearly mechanical, or following the sight, and therefore taxing the memory as little as possible.

"H. P.," *Engineer's Office, Medina.*—Your formula would interest so few of our readers that it has not been thought desirable to make the engraving necessary to the illustration. Our thanks are due for your offer, and any information which you may be disposed to furnish will be thankfully received.

To the Editor of Appletons' Mechanics' Magazine.

Looking over No 43 of "The Expositor," a weekly London publication, an article will be found on the subject of a bridge now in process of erection at Battersea, in which article the editor remarks—"There is a peculiarity in the mode of constructing this bridge which deserves notice for the boldness and novelty of the design, and which, if successful, will confer great credit on the originator. The piers, instead of being founded in a cofferdam and built of regular masonry, are composed of concrete, surrounded and protected on all sides by a substantial casing of cast-iron. Thus no cofferdam is required; and the engineer calculates that he will be able to carry up his piers to the height of seven feet above high water for the same sum that a cofferdam would have cost under the old system. If this mode of founding works in tidal rivers should prove successful, it will be a highly important step in hydraulic engineering."

Now, Mr. Editor, you will immediately perceive that the above plan of founding piers, without the use of cofferdams, bears great similitude to that proposed by me in an article lately addressed to you on the subject of a bridge across the river St. Lawrence—the only difference being that the engineer of the Battersea bridge makes a cast-iron casing wherein to inclose his concrete, whereas I propose a wrought-iron casing for much the same purpose. My article proposes that the iron casing be made air-tight—first, with the view of making it answer as a pneumatic pile, thereby driving it as deep as possible into the bed of the river to give it a firm hold; and secondly, with the view of pumping out the water, to allow of the construction of solid masonry without. The

pumping out of the water and the consequent expense might, however, very probably be dispensed with, by merely filling in the casing with a mixture of concrete and loose stone thrown in from above. The pier, then, in virtue of its outside casing, would be just as good as one of solid masonry, to say nothing of the great economy attained in its construction and in the materials employed. If there is any merit to be attached to the idea of an iron casing for founding piers without the use of cofferdams, I must claim that merit in the same degree that the editor of the *Expositor* confers it upon the engineer of the Battersea bridge; for it will be evident to you, Mr. Editor, that the date at which you received my first communication on the subject is anterior to that of my receiving the above-mentioned number of the *Expositor*, previous to which time I was not aware in any way of the construction of a bridge at Battersea.

Now, Sir, a few words as to the superstructure of the St. Lawrence bridge. You will perceive, by referring to page 130 of a work published by W. Fairbairn, Esq., C. E., on the subject of the Conway and Menai tubular bridges, that in one of his letters to R. Stephenson, Esq., he says—"I have been calculating the theoretical extent to which a tube of the description we are making could be carried, before it would break with its own weight; and I find from data deduced from the model tube, that the limit is about twenty-four times the dimensions, or a span equal to 1800 feet. I do not mean to say that we could find material, or that it is practical to build such a tube; but I am persuaded, in case we are successful with the Britannia and Conway, that a bridge 1000 feet span might be made. I, however, leave these gigantic structures to our successors, being conscious, as far as respects our present undertaking, that we are very considerably within the limits of destruction." Now the condition has, to every one's knowledge, been nobly verified in the existence of the Menai tubes; and when it is known that a train of freighted cars weighing 300 tons can cause but a deflection of three-quarters of an inch in a span of 460 feet, no doubt can remain in any one's mind as to the possibility of constructing a tube of double the dimensions. One pier more or less, as I stated in my first article, would involve an immense amount of money, on account of the great depth of the water and the subsequent height necessary above water, so that the longer the tubes could be made the more economical would be the cost of the bridge. If, however, there were any risk in three spans of 1000 feet each, the general rule of an odd number of bays might be overlooked, and four spans of 750 feet might be adopted with the most perfect safety.

I am now corresponding with R. Stephenson, Esq., and Wm. Fairbairn, Esq., civil engineers, on the subject of the proportions to be given to the requisite tubes, and shall soon have obtained something like a very definite idea of a bridge across the St. Lawrence, even though it has till now been considered impossible, and even though when made it should be considered the tenth wonder of the world.

A SUBSCRIBER.

Quebec.

"WACAMAHAGA."—Have received semi-official notification of our election to the important position of "vowel" to the Aboriginal Mechanical Association. We are well content to lend the aid of our name, if it be thought in any way conducive to the "euphony" of a society composed of such discordant elements.

 It would give us great pleasure to notice, under a proper head, such periodicals devoted to the mechanic arts or sciences as may be received in exchange with the *Magazine*; but only such can be noticed as are sent to the *Editor's address*.

APPLETONS'
Mechanics' Magazine and Engineers' Journal.

VOL. I.

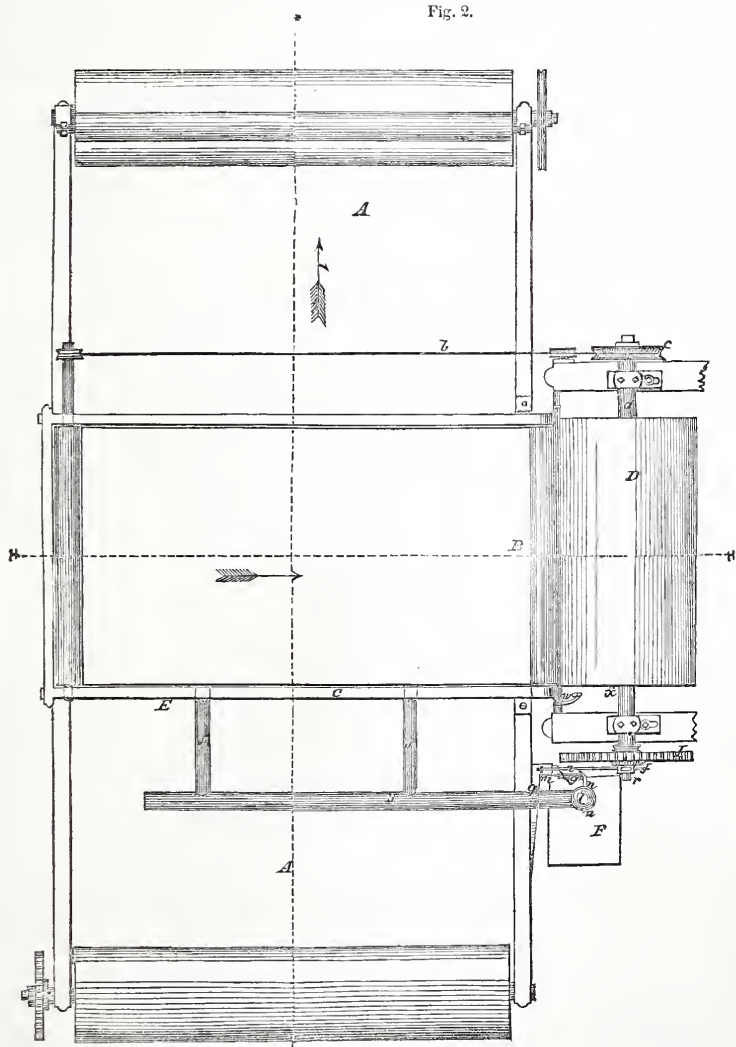
MONDAY, DECEMBER 1, 1851.

Edited by JULIUS W. ADAMS, C. E., 200 Broadway, New York.

No. 12.

ARNOLD'S MACHINERY FOR MANUFACTURING FELT-CLOTH.

Fig. 2.



IMPROVEMENTS IN MACHINERY FOR MANUFACTURING FELT-CLOTH OF WOOL, COTTON, OR OTHER FIBROUS MATERIAL, AND FOR CARRYING WEBS OF ANY FIBROUS MATERIAL, BY J. R. C. ARNOLD, OF NORWALK, CONNECTICUT.

From the Specification of the Inventor, patented June 10, 1851.

THE following is a description of the same.

Fig. 1 is an elevation of the machinery.

Fig. 2 is a plan or bird's-eye view of that part of the same to which my invention relates.

Fig. 3 is a vertical section through the line *xx* of fig. 2, looking from the opposite side to fig. 1.

Fig. 4 is a vertical section through the line *yy* of fig. 2.

Fig. 5 is a horizontal section of the vacuum-box and tubes communicating with the apparatus for producing the vacuum.

Figs. 6 and 7 are sections taken at right angles to each other of the vacuum-pipe.

Similar letters of reference indicate corresponding parts in each of the several figures.

My improvement relates to a new and improved mode of carrying webs or sheets of fibrous material, and when employed in the manufacture of felt-cloth is for the purpose of carrying the weft across and depositing it upon the warp. Felt-cloth is manufactured by crossing the fleeces or cardings of wool from the carding machines, and then pressing, blending, or matting them together into a sheet of compact texture. The usual mode of conveying the weft across the warp is by means of endless chains carrying combs with hooked teeth, from which teeth it has to be released in order to be deposited on the warp. These teeth frequently allow some portions of the material to fall or slip off too soon.

This difficulty I design to obviate by my improvement, which consists in the employment of an apron of some material pervious to air, as for instance hair-cloth. Between the rollers of this apron and between its upper and lower folds I place a hollow box or chamber which nearly fills the entire space; the bottom of this box is thickly perforated all over with small holes, and it communicates by pipes from one or both sides with a fan, blower, or other apparatus capable of withdrawing the air and forming a vacuum within. The air being

withdrawn from the box the external air rushes through the apron and through the perforations in the bottom of the box to supply its place, and any light, or fibrous material will be drawn towards the apron and securely held under it by the pressure of the atmosphere, without any liability to fall off till the desired moment, when the communication with the blower is cut off.

The carding machine represented in fig. 1, which supplies the fleece or carding for the weft, does not differ from other machines in use, and therefore needs no particular description here; that which supplies the warp is not shown.

AA is the apron which carries the warp, which is the same as usually employed; it moves in direction of the arrows 1 (figs. 2 and 4), and carries the warp on the top. *BB* is the apron carrying the weft, which, as has been before stated, is of material pervious to air; it runs on two collars *a a'* in a frame *cc* supported above, the frame carrying the warp apron. The apron *BB* receives motion in the direction of arrows 2 2 (figs. 1, 2, and 3,) through roller *a'* by a band *b* from a pulley *c* on the shaft *d* of the doffer *D* of the carding machine.

E is the vacuum-box, which is made of any sheet metal, and is of a length nearly equal to the space between the rollers *a a'*, of the width of the warp, and of a depth nearly equal to the space between the upper and lower folds of the apron; its bottom, perforated all over with holes *e, e, e, e*, touches or nearly touches the lower fold of the apron. A rotary fan in a box *F* is placed near the machine or in any suitable position for operating on several machines at the same time; a pipe *G* proceeds upwards from the box of the fan, having a pipe *H* leading from it near the top, which communicates by branch-pipes *ff* with the inside of the vacuum-box. In the lower part of the pipe *G* there is a throttle-valve *s*, which closes or opens the communication between the fan and the vacuum-box *E*; this valve has a lever *g* on its spindle, which is connected by a rod *h* to a long

Fig. 1.

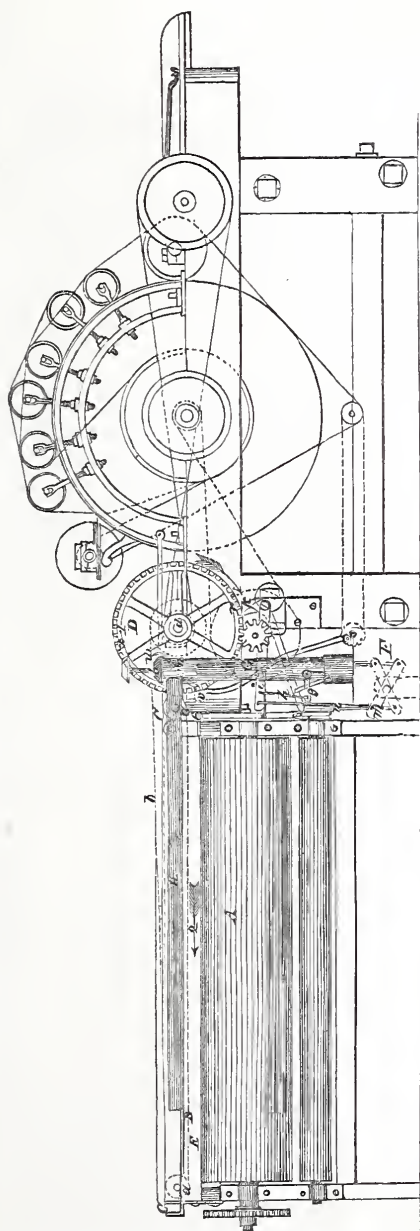


Fig. 4.

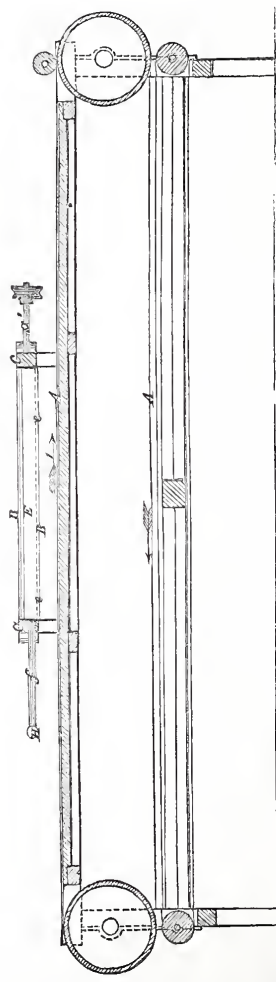
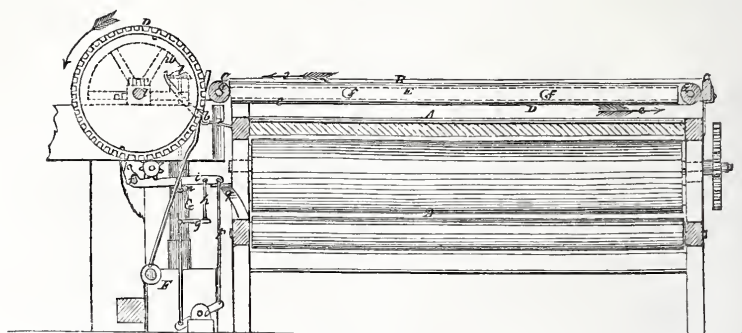


Fig. 3.



arm *i* of a lever hung on a fixed fulcrum *j* on the side of the frame of the carding-engine, the same lever having a shorter curved arm *k* set at nearly a right angle to the arm *i*. The top of the pipe *G* is open, but is covered by a valve *l* having two guide-rods *nn'*, one on each side, passing through ears on the outside of the pipe; the rod *n* is elongated below the ear and connected to one arm of a lever *m*, having its fulcrum in a standard *o*, and having two arms of equal length, the

opposite arm being connected by a rod *p* to the arm *i* of the lever to which the throttle-valve is connected. A spring *q* secured to the frame which carries the aprons *AA* and *BB*, always bears under the end of the lever-arm *i* and keeps it raised, causing the rod *p* to raise the end of the lever *m* to which it is attached, and throw down the opposite end causing the rod *n'* to close the valve *l* until it is opened by the means hereafter shown in the description of the operation of the

Fig. 5.

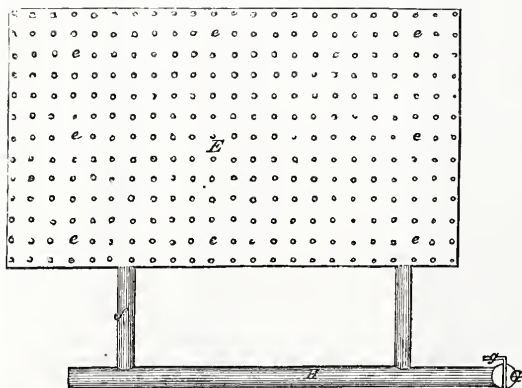
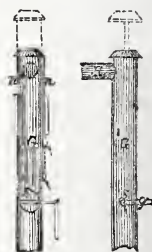


Fig. 6.

Fig. 7.



machine. The throttle-valve *s* is so arranged that it is always open when the valve *l* is closed, so as to leave a free communication from the box *E* through the pipes *ff*, *h*, *G*, to the box *F* containing the fan, or to any apparatus that may be employed for producing a vacuum. *I* is a toothed wheel on the doffer-shaft,

through which the doffer receives its motion; it carries a small stud *r* on its outer face, which, during the revolution of the wheel, strikes the arm *k* of the lever *ik*; *at* is a flap composed of a flat board or plate of the whole width of the doffer; it is hung on pivots or hinges *vv* on each side of the frame, and also has a lever *w*

attached to one end, which is struck by a pin *x* on the end of the doffer once during its revolution, so as to throw up the flap suddenly towards the apron *B B*.

The operation of the machinery, except as far as the mode of confining the weft below the apron is considered, is the same as in other machines employed for the same purpose, therefore I will proceed to describe the manner in which the weft is controlled.

The fan or other apparatus for producing the vacuum must be constant in its operation, so as to keep a constant draught or rush of air through the apron in the box *E*. The doffer makes one revolution for every sheet of weft that is formed; and therefore must correspond in diameter with the width of the warp. The warp travels a distance equal to the width of the weft during the time the weft is travelling across its upper face. The motion of both aprons is continuous, and the carding is taken from the doffer in the usual manner, from whence it proceeds to the under surface of the apron, where it is confined by the pressure of the atmosphere.

The speed of the apron *B B* is such as to take a sheet of carding produced by one revolution of the doffer *D* and carry it to a proper position for depositing on the warp during the time the warp moves a distance equal to the width of the weft. There is a space left in the cards on the doffer which causes a break in the carding when a sheet is formed, of the proper length, and as soon as this space comes opposite the apron, the pin *r* on the wheel strikes the arm *k* and throws down the arm *i* of the lever *ik* to the position shown in fig. 1 in red lines, the rod *h* instantly closes the throttle-valve *s*, and closes the communication with the apparatus producing the vacuum, and the rod *p* acting on the lever *m*, causes the rod *n'* to open the valve *l*, both valves being actuated simultaneously; thus the sheet is thrown from the apron *B B* suddenly and deposited on the warp by the sudden current of air which rushes through the top of the pipe *G*, escaping through the bottom of the box *E* and through the apron. The valves remain in the position last shown but an instant, or a very short space of time, for as soon as the pin *r* passes the arm *k* the spring *p* raises the arm *i* and brings the valves to the

position first described, the air entering the vacuum-box *E* through the apron *B B*; the space in the doffer on which there are no cards having then passed the take-off, the carding or web again commences being given off from the doffer and the end falls to the flap *t*; just at this moment the pin *x* strikes the lever *w* and throws up the flap, throwing the carding up to the apron where it is retained, and the operation proceeds as before described, the flap falling after the pin *x* passes the lever. This mode of carrying webs may be employed effectually for any fibrous material, and will be found advantageous from its not injuring, perforating, or tearing it.

BROWN'S IMPROVED LIME-KILNS.

From the Specification of the Inventor, Samuel Brown, of the township of Berwick, State of Pennsylvania.

FIG. 1 is a perspective view of the kiln complete.

Fig. 2 is a bottom view.

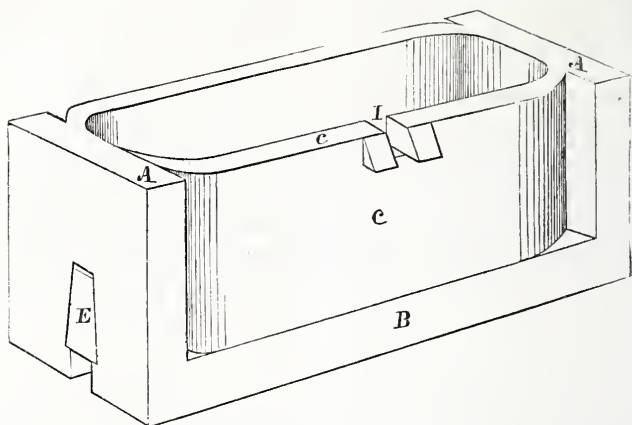
Fig. 3 is an end view; and

Fig. 4 a top view of the same.

Similar letters in the several figures represent like parts. The nature of my invention consists, first, in so forming the fire-space in lime-kilns, which are fired at both ends, as to rise gradually from the centre of the kiln, to points above the eyes in each end thereof, for the purpose of so distributing the draught and heat, as to secure the even burning of the same. Second, dividing the fire-space, by a partition wall in the centre, into two chambers, for the purpose of shifting and regulating the heat required in either end of the kiln for the more evenly burning of the same. Third, combining with the fire-chambers and partition wall the ash-pits, at each end of the kiln, connected by a narrow flue, so that when the eye at either end may be closed for shifting the heat, sufficient draught will be kept up from the opposite end of the flue to allow the fire to burn moderately, without being entirely extinguished.

The base of the kiln is of an elliptical form, having a flue *D* running through the centre thereof its entire length, and of a size suitable to the size of the kiln, and which flue terminates at each end in an ash-pit *H*, so that when the eye at

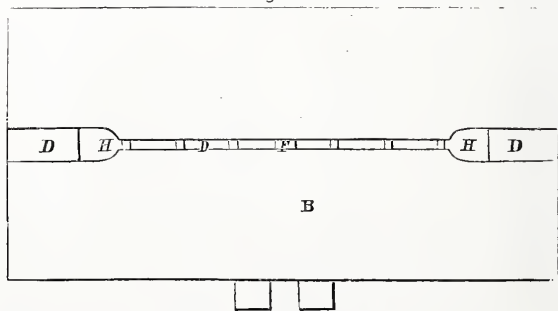
Fig. 1.



either end is closed, or partially closed, for shifting the heat, sufficient draught will be kept up from the opposite end to allow the fire to burn moderately. Upon this base or platform B, I build the side walls c; and at each end the breast walls A, which are run up with, and to the same height of the side walls, said breast walls being in length equal to the greatest width of the kiln. The side and

breast walls may be banked up with earth on the outside if preferred, or the kiln may be placed in a trench cut through a slight undulation of the ground, or against a side hill. Where the flue D opens out through the breast walls A, I construct the eyes E, which are gradually drawn in towards their tops, having suitable offsets therein, on which to rest the stone, when it is found necessary to

Fig. 2.



close, or partially close up said eyes, leaving always space enough at top to throw in fuel when necessary. By closing up the eye at either end the heat may be regulated, so as to burn faster at one end than at the other, and which will be found necessary in the burning of almost every kiln, so as to burn all alike, and leave no core or cinder.

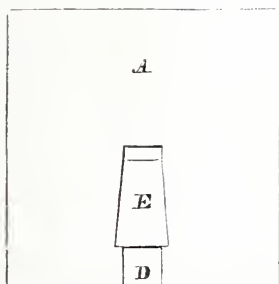
Across the centre of the kiln I build a partition or pillar F, of suitable height,

taking care not to choke the flue underneath it; and around the inside of the kiln I construct a bench G, upon which and the pillar F the arches rest and are turned. The benches G rise gradually from the level of the partition wall F, to points above the tops of the eyes at each end, for the purpose of so distributing the draught and heat as to secure the even burning of the stone.

Suitable bars should be placed in the

bottom of the kiln, which may be arranged for the burning of either wood or coal, and which should be so constructed as to prevent the fuel from choking up the flue. A "bushel-hole" I may also be left in the side of the kiln to facilitate the putting in of the stone or the taking out the lime.

Fig. 3.

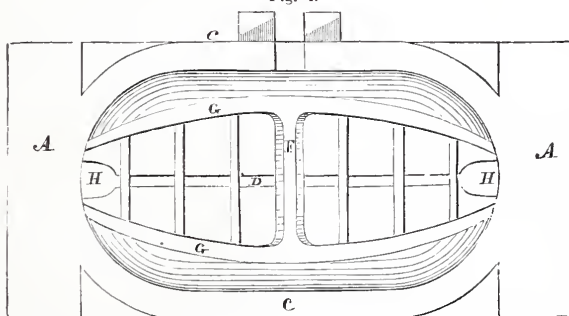


The partition wall *E*, which divides the fire-space into two chambers, is intended to aid in shifting the heat and regulating it in either chamber as may be required, so as to insure the more evenly burning of the stone.

I fire my kiln at both ends at the same

time. The draught is thus much stronger—the heat is applied much more generally and regularly throughout, and may at any time be increased or diminished at either end, so as to burn faster or slower, and equalize the burning of the stone. Much less fuel is required for burning the same amount of stone than in ordinary kilns, for the reason that the heat can be so economized as to only use it where actually required. A kiln constructed after my plan burns the same quantity as the ordinary kiln, in about one-half of the time. Instead of three days usually consumed, I can burn my kiln in thirty-six hours. The cost of construction is small, as from its shape it can be built on flat ground, or where a slight hillock presents itself, through or alongside of which it may be placed. It is very convenient for filling, feeding, and for removing the lime when burned. It requires no more hands than a common kiln, and yet half the time is saved. But one of its greatest excellences is, that I can manage the heat, and apply it front or back, so as to insure the burning of the stone evenly and regularly, and without leaving any core orinder.

Fig. 4.



Claims.—First, so forming the fire-space in lime-kilns, which are fired at both ends, as to rise gradually from the centre of the kiln to points above the eyes in each end thereof, substantially as herein described, for the purpose of so distributing the draught and heat as to secure the even burning of the stone.

Second, dividing the fire-space by a partition wall in the centre into two chambers for the purpose of shifting and regulating the heat required in either end

of the kiln, substantially as herein described, for the more evenly burning of the stone.

Third, in combination with the fire-chambers and partition wall, the ash-pits at each end of the kiln, connected by a narrow flue, so that when the eye at either end may be closed for shifting the heat, sufficient draught will be kept up from the opposite end of the flue to allow the fire to burn moderately without being entirely extinguished.

IMPROVEMENTS IN TREATING METALS.

From the Specification of the Inventor, Edward Lewis Seymour, of Williamsburg, New York.

Fig. 1 is a plan of the apparatus used by me.

Fig. 2 is a section thereof.

Fig. 3 is a cross-section of the furnace.

The same letters indicate like parts in all the figures.

My invention consists in the use, in combination, of several known principles or processes of metallurgical chemistry, which are hereinafter described, in the manufacture of zinc white, by which I am enabled to treat ores containing any number of metals; and whilst converting the metallic zinc, its oxide, or sulphuret, into the sulphate of the oxide of zinc (to be finally converted into zinc white or other pigments), to separate all the other metals contained in the ores by virtue of the chemical affinity of zinc or its oxide for sulphuric acid, formed in the manner described, with or without the aid of other chemical agents and affinities, according to the nature of the metals contained in the ores under treatment. For example, suppose the metals in solution to consist of the oxides of silver, copper, and zinc; before using zinc or its oxide as a precipitant, it is more proper and advantageous to precipitate the silver first by means, for instance, of metallic copper, so as to have no other metal besides copper to separate hereafter by means of zinc or its oxide. You see, therefore, clearly, that besides the chemical affinity of the oxide of zinc for sulphuric acid, I have to avail myself in this instance of that of copper—that is to say, of its oxide, for the acid in question. The same remark is applicable to chloride of sodium, the alkalies, alkaline earths, and their carbonates or chlorides, &c., which I have to use occasionally, in order to simplify the general process and to lose no time.

These processes commence first by conducting the sulphurous gas resulting from the calcination of sulphuretted ores of any description, in the presence of or conjointly with a regulated supply of atmospheric air and steam, both or either, through strata of felspathic rock, magnesian limestone, sulphurets of metals, or other substances, either partly calcined and lixiviated or not, thereby effecting the decomposition of any and all of these articles into their respective sulphates—

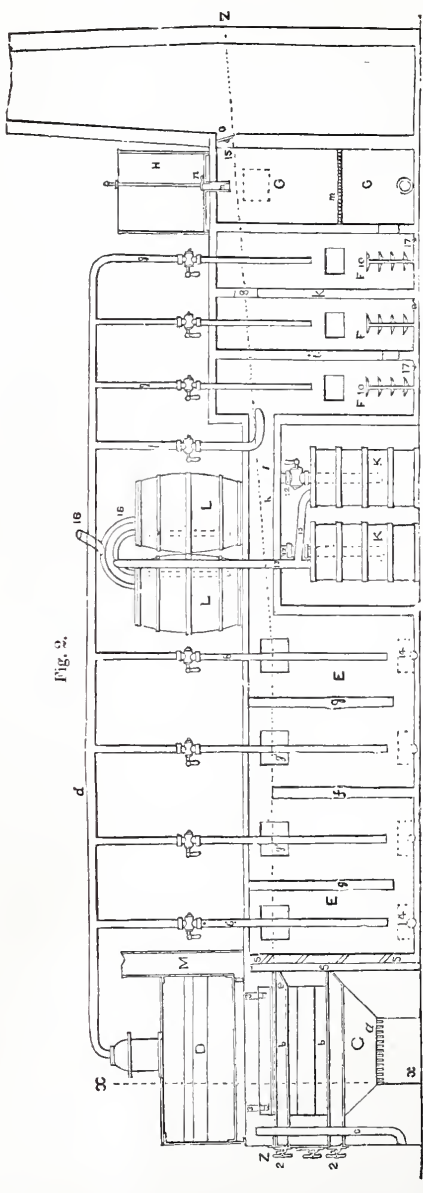
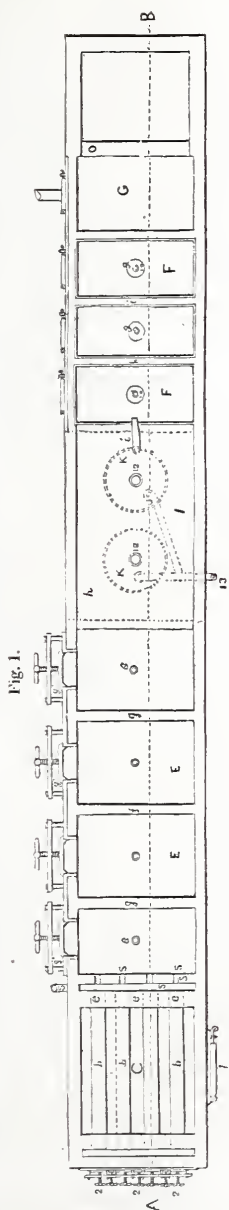
that is, sulphates of alumina and potash or soda, sulphates of magnesia and lime, and sulphates of iron, copper, zinc, lead, &c., according to the nature of the ores or substances under treatment.

In the second part of these processes, the surplus or unused surplus gas, either direct or from the first part of the process, is to be heated in leaden chambers or other vessels, and to be converted, by any usual or known means, into dilute sulphuric acid, for use in making sulphates from ores or metals, whether connected with the manufacture of zinc white or not, or treating the basic salts and the oxides formed by the calcination of the ores.

In the third part of these processes, whatever of the sulphurous gas and the nitrous gases (if such be used), evolved from the previous process, may be in surplus after either or all of the preceding parts of this process, is made available, without escape or loss, by combining it with crude or raw ammonia, or other alkaline substances, thereby producing the principal elements of artificial manures.

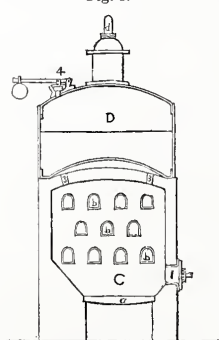
In the fourth of these processes, the decomposed or surplus sulphurous gas of the first operation, or the whole quantity evolved from the ore when the second and third operations are not progressing at the same time, is led into one or more reservoirs, in which water and metallic zinc being present, sulphate of zinc is formed and hydrogen gas is evolved; the sulphate of zinc is to be converted into white oxide of zinc by any known means, the sulphuric acid expelled, combined with alkalies during this part of the process, being made available for use in subsequent parts of the processes; the hydrogen gas is to be used for deoxidizing metallic oxides, or collected and used for the purpose of illumination, when previously charged with carbon from essential oils, or resinous matters, or any other ingredients known to be fit for the purpose. These several but successive, continuous, consecutive, or combined parts of this process being effected by one fire, which also heats the water in a boiler to supply steam for use in the processes, in the manner and by the means fully described.

In the accompanying drawings, c represents the furnace, a the fire-grate, and 1 the fire-door. 3 3 are flues in the



crown of the furnace, by which the fire-heat passes to heat the water in the boiler *D*, which has a safety-valve 4 and a steam-pipe *d* going the whole length above the other parts of the apparatus. *bbb* are iron or clay muffles set within the furnace *c*, with doors 2 2 2; and the wall inclosing the furnace is built with air-flues *cc* so arranged as to admit a current of air, which is slightly warmed as it passes into openings in the muffles, just within the doors 2. At *ee* are the mouths of the muffles *bbb*, and at this end are provided small air-flues 5, so set that they admit a current of air from without to unite with the sulphurous gases driven out by the heat from the materials that are under treatment in the muffles. At *M* is the chimney to the furnace *c*. The draught or supply of air into the flues *c*, and muffles and fire in the furnace *c* and flues 5, may either be the natural induction of the atmospheric air, or the supply may be increased by blowers and regulated by cocks or valves in any convenient manner.

Fig. 3.



The sulphurous gases from the materials under treatment in the muffles, and the air entering by the flues 5, commingle in the large air-tight chamber *E*, formed of brick or masonry, or any fit material, and constructed in any usual manner to secure permanency. The standing division *f* not reaching quite to the top of the chamber *E*, and the hanging divisions *g* not reaching quite to the bottom, are to be constructed to divide the chamber *E*, and form receptacles for sulphuretted ores of any nature, whether previously calcined and lixiviated or not, or any oth-

er ores, whether they be found in a metallic state or as oxides, as also felspathic rock and magnesian limestone, to be converted into their respective sulphates, and by subsequent treatment of the metallic sulphates with metallic zinc or its oxides, separated from each other, either with or without the aid of the chemical agents or affinities, as before stated; the finally resulting sulphate of zinc being converted into zinc white by any known means. At 6 6 6 are pipes and cocks from the steam-pipe *d*, above which, steam, uniting with the sulphurous gas from the materials in the muffles *bbb* and the air from the flues 5, passes successively below either of the hanging partitions *g* and over the standing partitions *f*, and operate to convert the contents of the chambers, as above stated, into sulphates of the material it comes in contact with. The commingled current of sulphurous gas, air, and steam that is not absorbed by and united with the materials in the chambers *E*, goes forwards into and through the long horizontal flue *h*, until it arrives in the chamber *F*; this chamber is lined with lead, and is fitted with one partition *i*, having an opening 7 near the bottom, to the space between the partition *i* and the next partition *k*, which has an opening 8, near the top, into the third division of the chamber *F*. At 14 are pipes to draw off any liquid contents of the chamber *E*. At *b* is a pipe and cock from the steam-pipe *d*, to admit a regulated current of steam when needful into the end of the flue *h*, by a nozzle turned towards the chamber *F*, to accelerate the passage of the sulphurous gas into the chamber *F*. At *qqq* are pipes and cocks admitting a regulated supply of steam from the pipe *d* above into the lower parts of the chamber *F*, and at 10, 10, 10 are vessels containing nitric acid; this acting with the surplus sulphurous gas from the first chamber *E*, and with the steam from the pipes *q*, condenses in the lower parts of the chamber *F*, in the form of dilute sulphuric acid, and may be drawn off for use by pipes 17 on each division. Or in lieu of leaden chambers, I use any other known means of converting the sulphurous gas into sulphuric acid.

The sulphurous and nitrous gases that are in surplus, or that are not taken up in the previously described parts of this

process, are to be passed out by an opening 11 towards the bottom, at the right-hand end of the chamber F, into the ammonia chamber G, which has a grating *m* across it to support a quantity of pumice-stone, coke, or other similar and fit material. At H, above the chamber G, is a tank or vessel fit to contain a quantity of raw carbonate or caustic ammonia, or any other cheap alkali, in solution. This tank has a pipe *n* and valve, to permit a regulated quantity of the ammonia or alkaline solution to descend into the upper part of the chamber G, through the coke and pumice-stone, in which they meet the surplus sulphurous or nitrous gases from the previous operations, and fall to the bottom of the chamber G in the form of alkaline salts or solution, containing the most important element of artificial manure, and in a fit state to mix with other substances for agricultural purposes.

I is the lower part of the flue *h*, under which are vessels *k* to contain water and the metallic zinc, and at 12 12 are pipes to admit sulphurous gas from the flue *h* into the lower parts of the vessels *k*, in which it operates to form the sulphuric acid which converts the metallic zinc into sulphate of zinc, and the hydrogen of the water into hydrogen gas, which, ascending by its levity and partial pressure, passes by the pipes 13 from the upper part of the vessels *k* into the vessels *l* above the flue *h*, which are fitted with pipes 16 to lead the gas into any convenient receptacle where it can be purified by lime or lime-water, or other substance, for any future use. Beyond the chamber *o* is a final flue to any common chimney having a damper 15, by which the exit of any gases may be so regulated as to maintain a slight pressure of the gases, if so needed, in the next and other previous parts of the apparatus.

By these descriptions of the several processes employed, it will be understood that sulphuretted ores of iron, zinc, copper, lead, or any other metal, being placed in the muffles and subjected to the usual process of roasting or calcining, the sulphurous gas evolved is not suffered to escape into the atmosphere and cause detriment and annoyance to the vicinity, but is applied to use in such a manner that when it is small in quantity it may be employed first and entirely in the pro-

duction of the sulphate of zinc, that may be afterwards converted into oxide of zinc to be used as a white paint or pigment, by evaporation and calcination, or any other known process, and that where the ores contain a large portion of sulphur, the sulphurous gas evolved in the calcination is so directed that all the foregoing processes may be progressing at the same instant of time, and felspathic or magnesian rocks or ores of any description, metallic zinc, and raw carbonate or caustic ammonia, or any other substances that have an affinity for combining with sulphurous gas, may all be converted into their respective sulphates and other salts, for use in the arts, by thus retaining the hitherto noxious sulphurous gas, and placing it in combination with steam and atmospheric air in active contact and combination with substances having an affinity for it, and for the sulphurous gas formed in the processes, thereby producing merchantable and commercial articles, at the same time protecting the general healthiness of the vicinity, instead of acting injuriously upon either animal or vegetable health or life. The hydrogen gas evolved in the described mode of converting metallic zinc into sulphate of zinc, is made available for illumination or other useful purposes.

The diluted sulphuric acid found in the chamber F can be used in producing oxygen or chlorine gases for chemical or metallurgical purposes; the first, by making it act upon peroxide of manganese; the second, by combining it with some peroxide and chloride of sodium or common salt. But the principal virtue of the diluted sulphuric acid formed in the chamber F, will be to make it act on the basic salts and the oxides formed during the calcination of ores, to convert such basic salts and such oxides into perfect sulphates of the metal then under treatment, and by introducing this diluted sulphuric acid in any convenient manner among the substances in the chambers E, and abstracting the portion that has percolated to the bottom of the chambers E by the pipes 14, and repeatedly returning the solution into the chamber again by any convenient means, the substances under treatment will be more rapidly converted into their respective sulphates by the solution acting conjointly with the

sulphurous gas evolved from the ores under treatment in the furnaces.

Claim.—The use, in combination, of the several processes described for the manufacture of zinc white, as a specific means of treating ores containing any number of metals; and separating the metals from each other by virtue of the chemical affinity of zinc or its oxide for sulphuric acid, as described; and this I claim with or without the aid of other chemical agents or affinities.

ISON'S IMPROVEMENTS IN MACHINERY FOR MAKING SPIKES AND NAILS.

From the Specification of the Inventor, Mark M. Ison, of Etowah, Georgia.

FIG. 1 is an elevation of that side of the machine where the iron is cut off and pointed.

Fig. 2 is an elevation of the opposite side, where the heading is performed,

and the spike or nail delivered from the machine.

Fig. 3 is a plan of the machine.

Fig. 4 is a plan of the table and carrier.

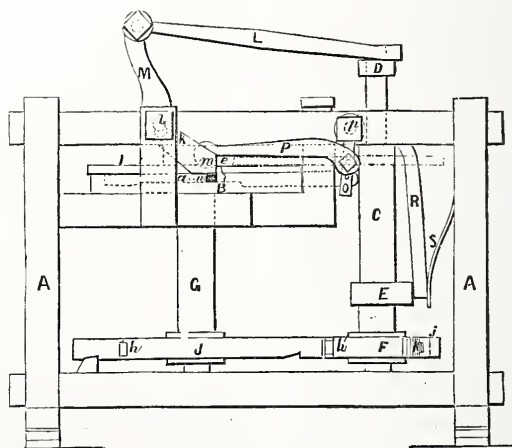
Fig. 5 is a transverse vertical section, taken through the machine in such a way as to show one spike just cut off and pointed, and another under the holding die in a position for heading.

Similar letters of reference indicate corresponding parts in each of the several figures.

My invention consists in a horizontal stationary table, nearly of the form of the segment of a circle, having a hollow space within it, in which works a revolving cam or carrier, hung on a shaft concentric to the table.

The iron from which the spikes are to be formed, which consists of a plate about the same width as the length of the spikes required, is fed along the up-

Fig. 1.



per surface of the table, and is cut off in strips of suitable size across the edge of an opening in the top above, and afterwards pointed between the said shear-arm and the table. The cam before mentioned, which revolves and becomes stationary at regular intervals, is then made to carry the spike round within the hollow space in the table, and allow it to stop under a holding die, which moves up and down in a line at right angles to

the face of the table and the motion of the carrier. This die is then, by a suitable movement, brought down upon it to hold it, while a heading tool, moving nearly in line with the spike, is caused by suitable mechanism to be brought into operation upon it and form the head.

A A represents the framing of the machine, consisting mainly of two uprights connected by longitudinal bars, and sup-

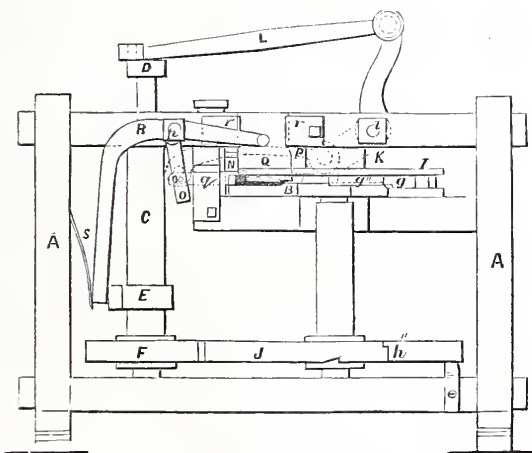
ported on a suitable base. B is the stationary table, which consists of a plate of metal of the form of a segment of a circle a little larger than a semicircle; it has a projecting rim *a* standing up from its face nearly all along the circular part of its face, and upon this rim a plate *i* is supported and secured, leaving a space between it and the lower part of the table. On the lower part of the table, at a distance from the inside of the rim equal to the intended length of the spike before heading, there is a slightly raised boss *c*, presenting the form of a segment of the frustum of a cone; the inclination of the periphery being the reverse of the inclination or bevel required for the point of the spike, is intended to form one side of the said point. Through the plate *i* there

are two openings—one, *b*, of considerable size, shown in figs. 3 and 5; and another, *d*, which is merely a slot through which the holding die passes, shown in fig. 5. The edge *e* of the opening must be steel-edged, as it is intended to form one cutting-edge of the shears which cut off the spike.

c is the main shaft, which is hung in suitable bearings in a vertical position; it carries at its upper end a crank *d*, whose wrist *f* has a very short throw for operating the vibrating shear, and it carries a cam *E* for operating the holding-down die, and a friction-wheel *F*.

G is a shaft hung in bearings parallel to *c*; it passes through the centre of the table *B*, carrying the three cam or earrier *H*, the three arms *g g' g''* of which fit in

Fig. 2.



the space between the bottom of the table *B* and the upper plate *i*: the front faces of the arms are nearly radial. The shaft *G* also carries a friction-wheel *J*, whose periphery is provided at three equidistant points with small projections or teeth *h h' h''*, at the back of each of which the periphery is slightly recessed.

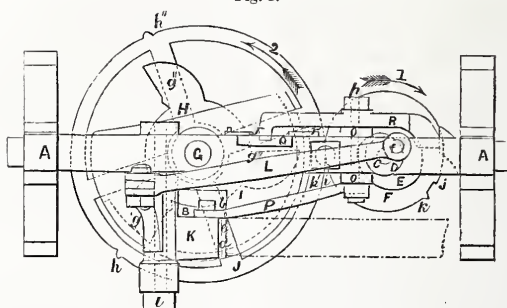
One part of the periphery of the wheel *F*, corresponding in length with each space on the wheel *J* between two of its teeth, is more prominent than the other part, which is recessed from *i* to *j*, see fig. 3, but has a small tooth *k* projecting near to *j*.

The prominent part of the periphery of

the wheel *F*, when in contact with the periphery of the wheel *J*, will, by the revolution of the main shaft *c*, cause it (the wheel *J*) to move on its axis by reason of the friction of contact, but the less prominent or recessed part passes without moving it—the starting of *J* being accomplished by the tooth *k* coming in contact with *h h'*, or *h''*.

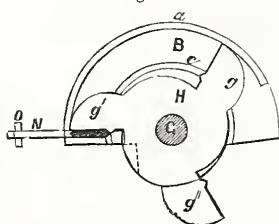
K is the vibrating shear-arm attached to a deep socket working on a centre-pin *l* secured in the frame; its edge *m*, or the whole arm, is steel, forming with the edge *e* a pair of shears; the under face of the arm is provided with a bevelled projection *n* at one end, which comes im-

Fig. 3.



mediately over the periphery of the conical surface *c*, and when the shear-arm is brought down presses or forms the point of the spike, after cutting it off. The shear-arm receives the necessary motion by means of a pitman *L* connected to the wrist *f* of the crank *D*, and to an arm or lever *M* on its own socket.

Fig. 4.

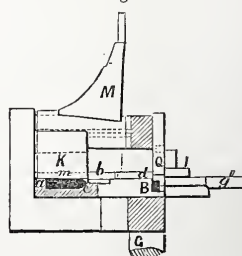


N is the header, which is attached by a pin *o* to a lever-frame *o*, hung on a stationary pin or centre *p*, secured in the frame; it works through a guide *g* in the frame, and receives the necessary motion at the proper time through a rod *r* connecting the lever-frame *o* with the vibrating shear-arm *K*.

Q is the holding-down die, which is of suitable form on its under side to hold the spike secure upon the table while the header is made to act upon it; it slides in guides *r*, and is brought down upon the spike at a suitable time and held down by means of a bent lever *R*, having its fulcrum on the pin *p*; one end of this lever is inserted in a suitable recess in the die, and the other end bears upon the cam *E*, being held against it by a spring *s*.

The operation of the machine is as follows: Rotary motion is given to the shaft *c*, by any convenient means, in the direction of the arrow 1, fig. 3; and the iron, being previously heated, is brought directly from the rolls on to the upper plate *i* of the table, and its end is presented a sufficient distance over the edge *e* to have a strip cut off of suitable width to form the spike, when the vibrating shear-arm *K* will be brought down, and will cut off the overhanging end of the iron between its edge *m* and the edge *e* of the spring *b*, afterwards forcing it down into the opening and down on the lower part of the table *B*, where it will form the point of the shaft *G* and carrier *H*, being stationary while the iron is being cut off and pointed. The shear-arm, after the cutting off and pointing, commences its upward motion to release the

Fig. 5.



spike, and as soon as this upward motion commences, the tooth *K* on the wheel *F* comes in contact with one of the teeth *h h'*, or *h''* on the large wheel, and sets the shaft *G* in motion, giving it one-third of a revolution in the direction of the ar-

row 2 in fig. 3, after which the point *i* on the wheel *E* passes the next tooth on the wheel *J*, and it (the wheel *J*) and the shaft *G* becomes again stationary by reason of the friction of the two wheels being diminished, while the next spike is cut off and pointed by another descent of the shear-arm, the iron from which the spikes are made being moved forwards previous to every descent of the shear-arm. By the motion just described as being given to the wheel *J* and shaft *G*, the carrier *H* receives a corresponding motion and carries the spike first cut off between the plate *I* and the lower part of the table *B* to a position in front of the heading or under the holding die, where, on becoming stationary, it allows it to remain. During the time that it is stationary, the cam *E*, operating on the lever *R*, brings down the holding die, which, together with the arm of the carrier, holds the spike in place, and the header being brought forwards by the next downward stroke of the shear-arm, the head is upset, or turned round the corner of the holding die *Q*. As soon as the head is formed, the holding die is raised by its lever *R* being forced by the springs against the less prominent part of the cam *E*, and the header is drawn back by the upward motion of the shear-arm, and by this time the wheel *J* and shaft *G* begin their motion again, and the arm of the carrier which brought the spike to the header pushes it out from the machine—the next arm behind it bringing the spike last cut off and pointed to a position to be held by the holding die *Q*, and headed.

This operation is repeated as long as the machine remains in motion, two spikes being always operated upon at once, one being cut off and pointed, while the one being cut off and pointed before it is being headed. In fig. 1 a spike is shown just cut off, and under the shear-arm being pointed; in fig. 2 one is shown being headed; and in fig. 5 one is shown at each stage of its manufacture.

Claim.—The arrangement of the carrier *H* within the hollow table *B*, substantially in the manner described; and also the combination of a carrier so arranged, with a single gripping die *Q* arranged with respect to it, in the manner substantially as shown, the die and the carrier assisting each other in holding the spike while being headed.

ON THE GROWTH AND TREATMENT OF FLAX.—NO. II.

Compiled from authentic sources.

FLAX is an annual plant, the "*Linum Usitatissimum*," and grows with a slender upright stem, branched near the top; the seed is sown in April, the plant blossoms in June or July, and it commonly ripens its seed in September. The fibre of which flax is composed, when examined under a microscope, appears to consist of smooth, transparent tubes, intersected, at short intervals, by joints or knots, similar to those of the bamboo or other reeds. The seeds are mucilaginous and emollient, and an infusion of them is frequently administered in inflammatory disorders; they also yield the linseed oil, well known in commerce, and which differs in some respects from most expressed oils, by congealing in water, and not forming a solid soap with fixed alkaline salts. Flax is, however, principally cultivated for the fibre yielded by its inner bark, which is spun into yarn, from which linen cloth is made.

According to the analysis of Liebig, flax is composed of the following materials:

Flax as it grows.	Hemp stem.	Leaves.
Carbon . . .	38·72	39·94
Hydrogen . .	7·33	5·06
Nitrogen . .	0·56	1·74
Oxygen . . .	48·39	48·72
Ashes	5·0	4·54
	100·	100·

When flax or hemp is steeped, and evaporated, the extract or residue consists of—

	Flax.	Hemp.
Carbon	30·69	28·28
Hydrogen	4·24	4·16
Nitrogen	2·24	3·28
Oxygen	20·82	15·08
Ashes	42·01	49·20
	100·	100·

The best flax has hitherto been produced in Belgium and the north of France, where great attention is bestowed upon it, and the land kept in the highest state of fertility. By care and proper cultivation, good flax may be grown on most kinds of soils, though some are better adapted for it than others; the texture,

composition, and quality of the soil, with regard to its fertility, is, therefore, deserving of much consideration. The French and Belgians give a preference to a sound, dry, deep loam, with a clay subsoil; light clays and alluvial soils will also do well under proper management; a mixture, likewise, of sand and clay, on a clay subsoil, is very suitable, but light, sandy, or gravelly soils, and very strong undrained clays, are to be avoided.

In all cases the land should be thoroughly drained and subsoiled, as a good crop cannot be expected where the land is saturated with underground or surface water. It must also be deep, as the roots of the flax will penetrate as much as two feet under the surface.

Experience has shown that it is not advisable to grow flax on the same ground, more than once in every eight or ten years. It should not, in any case, come after potatoes, or other green crops, or the fibres will be invariably coarse, and the stalks uneven, from the manure not being perfectly incorporated with the soil. The most important point connected with the cultivation of flax, is the proper preparation of the land. The objects to be attained, are good drainage, a complete eradication of weeds, and a thorough pulverization of the soil. Land intended for flax should receive a deep ploughing in autumn, as soon as the previous crop is removed. In this state it remains all winter, and early in spring it should be well harrowed, and the weeds which are brought to the surface carefully collected and removed from the field.

SOWING.—The seed imported from Riga has hitherto been considered best adapted for the generality of soils, though some are of opinion that Dutch seed is better for heavy soils. The seed should be plump, shining, and heavy, and before being sown should be sifted through a zinc perforated sieve, twelve bars to the inch, to clear it thoroughly of weeds. In the choice of seed, great care is necessary, and on no account should an inferior quality be used. It must then be sown broadcast, and as evenly distributed over the surface as possible: in England it has been successfully sown with a close drill. It is then covered in with a slight harrowing, after which a roller should be passed over the ground to insure quick and even germination. The quantity of

seed sown will in some measure depend on the chief object in view in the cultivation of the crop. When the quality of the fibre is the principal consideration, thick sowing is necessary, but if the seed is the primary object, it will better be attained by sowing thinner. The proper quantity of seed is $2\frac{1}{2}$ to 3 imperial bushels of seed to the statute acre, and if the quality is inferior a little more may be added. It should be sown as early as possible in April, in a sunny situation, as the sooner it is sown the sooner it is ready for pulling, and early sown flax is often of a better quality. Sowing clover and grass seed with flax has always an injurious effect on the latter, and should be avoided.

When the plants are about three inches high, which will be in about a month, they should be carefully weeded, though, if the land has been properly cleaned, few weeds ought to appear.

The time when flax should be pulled is a point of much nicety to determine. If a fine fibre is wanted, it should be pulled rather green, but if the seed is the principal object in view, a somewhat longer time should be given. The best criterion to judge of the proper time of pulling, is when the seeds in the boll begin to change from a green to a pale brown color, and when the stalk assumes a yellowish hue as far as about half its length from the ground, and to lose its leaves. Pulling should only be done in dry weather, and should not be commenced before the dew is off in the morning. It is very essential to keep the stalks even, like a brush at the root end, and the short stems should be kept separate from the long ones. The handfuls of pulled flax should then be laid across each other diagonally, to be ready for the operation of rippling, or taking out the seed, which ought to be done the same or the following day, otherwise the heads of the stems become hard, and are liable to get broken by the force necessary to draw them through the rippling machine. This apparatus is of a very simple character: it is an instrument like a comb, with iron teeth, round, smooth, and tapering, about 12 inches long, fastened into a wooden frame, and placed so close that the pods cannot pass through. This frame is screwed on the middle of a nine-foot plank, resting on

two stools. The riplers sit astride this plank at opposite ends, at such a distance from the comb as to permit of their striking it properly and alternately. As the handfuls of flax are drawn through the comb, the seed falls on a winnowing sheet below, where it is collected, and afterwards gently dried, when it is ready for use.

The seed having been taken from the flax, the next operation is the separation of the fibre from the stem, which is the most difficult part of the whole process. Before we enter upon the consideration of the modes of effecting this, it will be necessary to make a few observations on the structure and chemical nature of the plant. It consists of a woody *heart* or *boon*, and the *harl*, or flax fibre (covered outwardly with a fine cuticle), and situated between the exterior bark and the interior wood, which incloses the former like a tube. In its natural state, the fibres are attached firmly not only to the heart but to each other, by means of a green or yellowish substance. The rough stems of the flax, after being stripped of their seeds, lose in moisture by drying in warm air from 55 to 65 per cent. of their weight, but somewhat less when they are quite ripe and woody. In this dry state, they consist in 100 parts of from 20 to 23 per cent. of *harl*, and from 80 to 77 per cent. of *boon*. This latter is composed upon the average of 69 per cent. of a peculiar woody substance, 12 per cent. of a matter soluble in water, and 19 per cent. of a matter not soluble in water, but in alkaline leys. The harl contains at a mean 58 per cent. of pure flaxen fibre, 25 parts soluble in water (apparently extractive and albumen), and 17 parts insoluble in water, being chiefly gluten. By treating the harl with either cold or hot water, the latter substance is dyed brown by the soluble matter, while the fibres retain their coherence to one another. Alkaline leys, and also, though less readily, soap and water, dissolve the gluten, which seems to be the cement of the textile fibre, and thus sets them free. The cohesion of the fibres in the rough harl is so considerable, that, by mechanical means such as beating, rubbing, &c., a complete separation of them cannot be effected, unless with great loss of time, and rupture of the filaments. This cir-

cumstance shows the necessity of having recourse to some chemical mode of decomposing the gluten. The process hitherto employed with this view is a species of fermentation to which the stalks are exposed; it is called "retting," a corruption of rotting, since a certain degree of putrefaction takes place. When this process is completed, the boon or woody heart can be removed by the next operation, called "breaking," and other subordinate processes. The harl freed from the woody parts contains still a multitude of fibres, more or less coherent or entangled, and of variable lengths, ill adapted for spinning. These are afterwards removed by the heckle, or hatchel, which separates the connected fibres into their finest filaments, removing those that are too short, and disengaging the longer ones. The method by which the mucilaginous matter surrounding the fibre is made to undergo this process of fermentation, for the purpose of facilitating its separation from the woody stem, is by steeping it in ponds or streams of water, where it remains 8, 10, 12, or even 14 days, according to the heat of the weather, or the ripeness or dryness of the flax. As soon as it has remained a sufficient time in the water, it will be observed to sink in the pond, and the fibres will separate freely from the stalks on being broken and rubbed. This process requires the nicest care and attention, and it constitutes the principal difficulty attendant upon the cultivation of flax. If it remains too long in the water, the fibre itself undergoes decomposition, and is more or less injured, whilst, if it remain in too short a time, a considerable waste is entailed in the subsequent operations of scutching, by the fibres not being sufficiently liberated. River or soft water is the best for steeping flax. If spring water be used, the ponds ought to be filled some months before the flax is put in, that the action of the sun and air may soften it; and water containing any iron or other mineral substance should never be used. The ponds should be $3\frac{1}{2}$ to 4 feet deep, and a convenient width is 12 to 18 feet. The flax is placed loosely in the pool in regular layers somewhat sloped, with the root end underneath; and it must then be covered over with a coating of straw, or thin sods, to keep off the light. As the fermentation proceeds,

stones must be placed on this covering, just sufficient to keep the flax well under the water. Although a considerable current of water through the pond is not desirable, a small stream, sufficient to remove the impurities separated from the flax, is essentially necessary to insure a fibre of a good color. It will be observed that this method of steeping by cold water is a very tedious and uncertain process, fraught with great risk to the farmer inexperienced in these matters; so much so, that notwithstanding the lucrative nature of the crop, when well managed, it has required great exertions, on the part of the Irish Flax Improvement Society to prevent a rapid and alarming decrease of the cultivation of this important article. Considerable attention has lately been bestowed on flax steeping, with a view of shortening this decomposing process, and within the last two years a method has been introduced, which is probably calculated ultimately to supersede the ordinary mode. It is effected by placing the flax, after pulling and beating off the seed, in vats filled with water, and heated by steam to an average temperature of 90 degrees, by which means the setting is effected in about 66 hours. By this process the fibre is more uniformly watered, and being entirely under the eye of the attendant, it is retted to the exact degree requisite, and the flax thus produced is found to be superior to that watered in the ordinary way. This system was introduced into Ireland by the late Mr. Schenck, a citizen of the United States, and is now carried on very extensively in Ireland, by Messrs. A. Bernard and Koch, Belfast. One of the great advantages of this plan is, that a rettery, or steeping establishment, can be put up sufficient to prepare the produce of from 100 to 500 acres of flax for from £1500 to £2500, so that the business becomes worthy the attention of a person sufficiently intelligent to make himself thoroughly conversant with the nature and treatment of flax, and worth his while to put up proper machinery to scutch it in a more economical and effective manner for the market, than can be done by small farmers who only prepare the produce of their own farms. In Courtrai, the flax is steeped a short time and then dried, and afterwards put in stacks for six or twelve months. It is

then retted in the ordinary manner, and the fermentation in the stack is found materially to enhance its value.

There is again another method of retting the flax, by the action of the air, dews, and rain, called *dew retting*, though in a much slower manner. The flax, with this view, must be spread out thin upon meadow or grass land, and turned over from time to time, till the stems, on being rubbed between the fingers, show that the fibre and the woody heart are ready to part. The duration of this operation depends, of course, very much on the state of the weather, and extends from two to six or eight weeks. The loss by this mode is somewhat less than by water-retting, and the fibres are of a brighter color, and more delicate to the touch, but the yarns from dew-retted flax turn a dark color in boiling, though they bleach white.

The last plan which we will notice, of effecting the liberation of the flax fibre without steeping, is that recently patented by Chevalier Claussen, whose scheme for mixing flax with cotton, silk, or wool, has lately excited considerable attention. He proposes in the first place to break the wood of the fibre, by passing it between fluted rollers as above described, and then to remove as much of it as possible by mechanical means, after which he boils it for about three hours, in water containing about one-half per cent. of caustic soda. After this process, the flax is immersed in water containing one-fifth per cent. of sulphuric acid. M. Claussen says that this process completely separates the integral fibres from each other, and from the wood, and all that is afterwards necessary is to dry it, and scutch it in the ordinary manner. The next operation by which he prepares the fibre for mixing with cotton, &c., is to cut it by a suitable machine into the required lengths, then to saturate it in a solution of soda, allowing it to remain there a sufficient time for the liquid to permeate, by capillary attraction, into every part of the small tubes. The fibre is then taken out and immersed in water containing one-half per cent. of sulphuric acid. The action of the acid on the soda contained in the tubes, liberates the carbonic acid which it contains, the expansive power of which causes the fibres to split into the proper degree of fineness. It is then

Fig. 2.

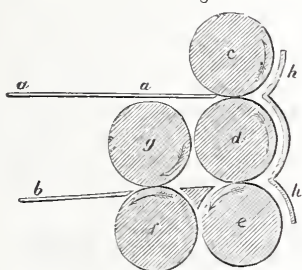
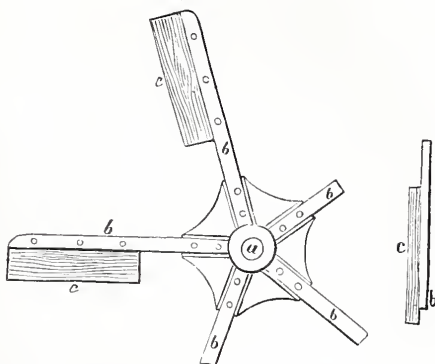


Fig. 3.



bleached, and after being dried, is carded on cotton machinery, and mixed in any required proportion with cotton, &c. It would, of course, be premature to speculate on the ultimate success of this plan, but we believe the experiments of M. Claussen have not been hitherto sufficiently successful to induce the immediate anticipation of any very beneficial results.* After the flax is sufficiently watered by the ordinary plan of cold water, it is taken out of the ponds, and after lying a few hours on the banks to drain, it is spread equally and evenly, about half an inch thick, on clean, short, thick pasture land. After remaining in this state for two or three days, it is turned over by means of long rods about eight feet long, and this operation is repeated every three or four days, until it is equally bleached and dried, and the decomposition of the woody heart fully effected. After some 8 to 12 days, it may be taken up and tied up into small bundles, and it is then ready to be scutched. The breaking is effected as follows:

Fig. 1.



A simple hand-rake is frequently used in some districts. It consists of an arrangement indicated in figure 1. It affords a

good exemplification of the rationale of the "breaking process." Suppose *a a* to be an under bench, before which the workman stands, three bars *b* are placed longitudinally on this, and parallel to, and at a certain distance from each other; a lever, movable on the fulcrum *c*, has two bars placed on its under side so arranged that they pass between the bars on the bench. The flax to be broken is placed on the under bars, the upper lever being brought repeatedly down, the flax being turned over and over. In the improved machines the fluted rollers present projections, corresponding to the bars in the above comparatively rude machine; while the motion of the rollers being continuous, the operation is necessarily facilitated; the pressure on the rollers, and consequently on the flax passing between them, is regulated by levers and weights. The most recent improvements in flax-breaking machines, is that registered by Mr. Plummer, the patentee of improved flax machines. The annexed diagram will illustrate the arrangement of this machine. The flax is laid upon the table *a a*, and taken up and passed between the two fluted rollers *c d*, the circular bent plate causing the flax, partially broken by the front rollers, to pass between the rollers *d* and *e*; issuing from these it is delivered to *f* and *g*, and finally passes from the machine by the table *b*. The arrows indicate the direction in which the rollers revolve, and consequently of that in which the flax moves. Instead, however, of following the direction shown in the diagram, the flax may be delivered to the machine by

* It now appears that all the claims of M. Claussen to improvements in the manufacture of flax may be regarded as of little, if any, practical value.
—Ed. M. M.

the table *b*, pass through between *g* and *f*, then between *a* and *e*, bent round by the plate *h h*, and delivered to *c* and *d*, and thence to the table *a a*. If the flax is not properly broken by passing once through the machine, the operation may be repeated. The inventor states that the principal novelties of this arrangement are, that the straw passes three times through between a less number of fluted rollers than usual, and that by means of the guide-plate (*h h*) it is made to bend round the middle rollers; the consequence of which is, that the flax is more effectually operated upon than by any other machine in use. The flax, after passing through the breaking machine, is scutched, the operation of which is to break and remove the woody heart, and to leave the simple fibre as pure as possible. This is effected in a variety of ways: in Belgium it is done entirely by hand—in Ireland both by hand and a rude description of machine. A good scutching apparatus is, however, yet a desideratum, as all in use at present are of an imperfect character, and entail consider-

able waste of the fibre. One method is to subject the flax to the action of rapidly revolving blades *c c*, fixed on radial arms *b b* on the main shaft *a*. The objections to this machine are, the rigidity of the blades, the rapid rate at which they revolve, and the liability of the flax to be blown about, in the case surrounding the blades, by the currents of air created in the machine, and wound or curled upon the radial arms by which their ends are cut off and reduced to the state of tow.

We have now concluded a description of all the operations conducted by the farmer; and the flax when scutched is made up into bundles, and is then ready for sale to the spinner. It will be observed, that considerable skill is required for the production of this important article, and its value depends on the care bestowed upon it. The price varies in England from £30 to £200 per ton, so that there is a very wide margin for skill and enterprise on the part of those who engage in its cultivation.

(To be continued.)

For Appletons' Mechanics' Magazine and Engineers' Journal.

NOTES ON THE U. S. STEAMER "PRINCETON."

BY B. F. ISHERWOOD, CHIEF ENG. U. S. NAVY.

Continued from page 625.

I WILL now give the performance of the vessel under the most trying condition for a screw propeller; viz., directly against a fresh head-wind. The mean perform-

ance of the "Princeton" for 47 hours under this condition was 4 knots per hour; mean steam pressure in boiler $10\frac{8}{16}$ pounds above atmosphere, cutting off at three-eighths from commencement of stroke; mean revolutions of propeller per minute 18.45, throttle one-sixth open; consumption of anthracite coal per hour 1170 pounds. Calculating the slip as before, we have it

$$32.44 \times 18.45 \times 60 = 35911.08 = \text{speed of propeller per hour in feet.}$$

$$6082\frac{2}{3} \times 4 = 24330.67 = \text{" " vessel " " " "}$$

$$11580.41 = \text{slip of propeller " " " "}$$

or $32\frac{1}{4}$ per cent.

In observing the small slips given by the Princeton's propeller with the vessel under sail, viz., only 1.04 and 5.13 per cent., the idea occurred to me that the reader might suppose the propeller in these cases to be exerting but little or no power, that is, was not thrusting or screwing the vessel forward; such, however, was by no means the case; the propeller in such instances was exerting its full power, as was proved by the facts of the great consumption of steam and the

few (comparatively to the steam-pressure) revolutions made. Had the resistance of the vessel been taken from the screw by the action of the sail, it would have been driven around with great velocity by the steam-pressure used, as there would have been but little more than the resistance of the friction of its surface on the water to be overcome: instead of which the number of revolutions were but slightly increased from what they would have been with the steam-pressure

had no sail been used, proving the resistance of the vessel was upon the propeller.

To definitively settle this question, a conclusive experiment was tried with the British screw war-steamer "Rattler." This vessel being tried under steam alone had a speed of 9.375 knots, the engines making $26\frac{1}{2}$ double strokes per minute; the dynamometer was applied and the thrust of the screw ascertained. The pitch of the screw was 11 feet, and it made four revolutions to each double stroke of the engines. Its slip was consequently as follows:

Speed of screw per hour	69300.0 feet.
" " vessel " "	57562.5 "

Slip of screw " "	11737.5 "
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or 17 per cent.

The sails were now set and the vessel made 12 knots, the engines making only $28\frac{1}{2}$ double strokes per minute. The slip was now as follows:

Speed of screw per hour	75240 feet.
" " vessel " "	73680 "

Slip of screw " "	1560 "
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or 2 per cent. only.

Or the speeds of the vessel and screw may be considered sensibly as equal. It was now supposed that the screw was exercising no pressure upon the water, but upon again applying the dynamometer to the screw-shaft, it was found that the forward thrust was the same as before. The screw was therefore producing a full effect.

I have frequently observed, during the time I was attached to the Princeton, that when the vessel by the aid of sails and a brisk wind was making a greatly increased speed, that the revolutions of the propeller were but slightly increased, the boiler, steam-pressure, throttle, and cut-off remaining sensibly the same. Now it is obvious that the pressure upon the piston remaining sensibly the same, as the foregoing conditions prove it must have done, the revolutions of the propeller should be nearly as the resistances or loads upon it; that is, if the resistance or load were *decreased* one-half, the number of revolutions should be *increased* nearly twice; but the number of revolutions were but slightly increased, proving

the resistance or load upon the screw to be but very slightly decreased, as will appear from the notes in the table on the following page taken at the time.

The same table will also illustrate pretty accurately the effect of sail in addition to the steam-power, and show how peculiarly effective such a combination is with the screw-propeller. As the speed of the vessel increased by the power of the wind on the sails, the engine, throttle, and cut-off, and the boiler-pressure remaining about the same, the revolutions of the propeller were but slightly increased, although it was still giving out its full thrust: were it not giving out its full thrust, the number of revolutions under such conditions must have been greatly increased. In this manner it will be perceived that the action of the sail did not interfere materially with that of the engine; each producing separately, as it were, its own effect, independently of the other.

One of the most striking results from the application of auxiliary sail, is seen in the great reduction of the slip of the screw. From this fact some important practical conclusions may be drawn.

In the first place, the mode of estimating the economical value of the screw from its quantity of slip, supposing the less the slip the greater the economy, is a very false one, when it is considered how great a proportion of the power of the engine is absorbed in the friction of the surface of the screw on the water. Now the amount of slip, other things equal, is regulated by the amount of *propelling* surface in the screw; not in an inverse proportion (as for example, doubling the *propelling* surface will not halve the slip), but in a less ratio; while the friction, other things equal, will be as the *whole* surface of the screw moving through the water. It is evident that the most economical proportion for the screw is that which gives, *not* the minimum of the loss by slip *alone*, but the minimum of *all* the losses; and as decreasing the surface does not decrease the slip in a direct ratio while it decreases the friction in a direct ratio, it is apparent that a considerable slip may be consistent with the most economical use of the power. In fact, it is found in practice that a slip of 25 per cent. gives the best results, economically

DATE.	Speed of vessel in knots of 6082½ feet per hour.	Revolutions of screw and double strokes of engines per minute.	Boiler pressure in pounds above atmosphere.	Throttle-valve open.	Cut off at from commencement of stroke.	Slip of screw per cent.	WIND AND SAIL.
Nov. 3, 1846	7.4	23.2	10.7	1-8th	3-8ths	0.3	Sail set to top-gallants. Light breeze abeam.
" 4, "	6.4	21.7	9.2	"	"	7.8	No sail set. do.
Sept. 9, "	8.67	28.4	13.2	1-4	"	4.6	Sail set to top-gallants. Moderate breeze abeam.
" 22, "	5.67	22	12.8	"	"	19.5	No sail set. do.
" 14, "	8	26	13	"	"	3.8	Sail set to top-gallants. do.
" 21, "	6.33	22.8	12.7	3-16	"	13.2	No sail set. Calm.
" 7, "	8	26	12.3	"	"	3.8	Sail set to top-sails. Light aft breeze.
Aug. 23, "	7	25	12	"	"	12.5	No sail set. Moderate wind ahead.
" "	8.5	27	"	"	"	1.6	Sail set to top-gallants. do. free.
Sept. 8, "	8.25	29	14	1-4	"	11.1	Sail set to top-sails. Light wind free.
" " "	7	29	"	"	"	24.6	No sail set. do. ahead.
" 9, "	7.33	27	13	"	"	15.1	Sail set to top-sails. Light wind forward the beam.
" 1, "	7	27	14	"	"	19	No sail set. do.
Oct. 2, "	3.5	12.3	8.6	1-16	"	11	No sail set. Moderate head wind.
" 3, "	4.25	13.3	6.8	"	"	0	Sail set to royals. Wind very light and free.
Nov. 2, "	7	23	12.3	3-16	"	4.9	Sail set to royals. Light wind abaft beam.
" 3, "	6.4	23	10	"	"	13.0	No sail set. Calm.
Dec. 2, "	5.5	22	10	"	"	21.9	No sail set. Light wind ahead.
" " "	6.75	23	"	"	"	8.2	Sail set to top-sails. do. free.
" 11, "	5.5	22	"	1-4	"	21.9	No sail set. Moderate head wind.
" 12, "	6.5	23	9	"	"	7.7	Sail set to top-sails. Moderate wind forward beam.
July 18, "	3.5	17.7	12	5-16	"	38.2	No sail set. Strong head wind and heavy head sea.
" 17, "	5.0	21	14	"	"	25.6	Courses and fore-and-aft sail set, sharp braced on a moderate wind. Very heavy head sea.
" 19, "	5.7	23	12.7	1-8	"	22.5	No sail set. Moderate head wind.
" " "	7	23	12	"	"	4.9	Sail set to top-sails. Moderate wind just free.
" 16, "	6	23	12	3-16	"	18.5	No sail set. Moderate head wind.
" 17, "	8	25	13	"	"	0	Sail set to top-gallants. Moderate aft wind.
Sept. 19, "	6	24	14	"	"	21.9	No sail set. Moderate breeze ahead.
" " "	7	24.3	13	"	"	10.0	All fore-and-aft sails set. Braced up on moderate wind.
Sept. 17, "	7.7	27	13	1-4	"	10.9	Fore-and-aft sail set. Ship on the wind. Moderate breeze.
" " "	7.1	"	"	"	"	17.8	No sail set. Moderate breeze ahead.
Nov. 1, "	5	20.3	10	3-16	"	23	No sail set. Light head wind.
" 2, "	6.2	22	10.4	"	"	11.9	Sail set to top-gallants. Light wind forward the beam.
Nov. 3, "	6.75	22	10	"	"	4.1	Sail set to top-gallants. Moderate wind abeam.
" " "	6.1	21.7	"	"	"	12.1	No sail set. Light airs abeam.
Jan. 25, 1847	6.4	22.3	10	1-4	"	10.3	Sail set to top-gallants. Light breeze abeam.
" 26, "	6	22.3	"	"	"	15.9	No sail set. Calm.

and potentially. By a slip of 25 per cent. is meant that slip under steam alone. If now the ship carry the usual proportion of sails for its size, and if those sails can be advantageously used for a large portion of the time—and they can be for three-fourths of the time, taking the mean of many months cruising—

and if the use of those sails operate a considerable reduction of the slip of the screw, say a mean reduction of 12 per cent., which was about the case with the "Princeton;" it is evident the surface of the screw can be still further decreased, so as to make the mean slip for steam alone and steam and sails 25 per cent.

This would make the slip 34 per cent. under steam alone, and about 22 per cent. under sail and steam; operating a considerable reduction of the friction, besides being followed by the very great practical advantages of lessened size, weight, and cost of propeller.

SCREWS OF THE "PRINCETON."—The "Princeton" was originally fitted with Ericsson's screw. This form of screw-propeller was originally patented by Ericsson in 1838, and was first essayed in England, where it met with no success, proving inferior to the rival form known as Smith's propeller. In some comparative experiments made with it and Smith's in the small government experimental "Bee," it gave such inferior results as completely proscribed its use in England.

The form of submerged screw-propeller, known in this country as Ericsson's, is the invention of a French officer, Captain Delisle, who presented it in a Memoir written to the French Minister of Marine in 1823. The essential characters of this propeller are as follows:

It is composed of six exterior blades, forming in the aggregate two-thirds of the pitch; these blades are fastened to an interior drum of one-half the width of the blades (in the direction of the axis), which drum is attached to the hub by arms of helicoidal form, forming in the aggregate one-third of the pitch. The proportion of the pitch of the screw to the diameter is about 2.50 to 1.00. The engines are attached direct to the propeller-shaft, without intermediate gearing.

The only propellers of this kind ever used in France, its native land, that I am aware of, are "l'Etoile" of 20 H. P. The "Bretagne," the "John Ericsson" of 45 H. P., and the "Pingouin" of 40 H. P. These vessels were constructed previously to 1844, in the infancy of screw-propulsion knowledge, and the results did not seem sufficiently favorable to cause the further use of this kind of propeller, which I believe is now nowhere used.

Captain Delisle in his Memoir says, that he lessened the proportion of pitch (one-third) used in the arms over that used in the blades (two-thirds), because the surface in the arms displaces the water chiefly laterally. The use of the band or drum is founded on the con-

sideration, that the water offers a greater resistance to the blade in its lowest position than in its higher position, consequently the same blade sustains a greater strain when in a lower than when in a higher position, but the blade must have strength enough to sustain the maximum strain or pressure to which it may be exposed; it will consequently have an excess of strength when in the higher position; if now this excess of strength of the blade in higher position could be transferred to the blade in lower position, a less strength of blade would be sufficient and attended with reduction of weight and cost; and this transference is what is attempted by the use of the drum. A little consideration, however, will show this to be impracticable. It will be observed that the drum is positioned at right angles to the axis of the propeller, while the blades or surfaces which it unites are oblique to the propeller-axis. Now as fluids are always pressed in directions at right angles to the pressing-surface, the reaction of the blades would be obliquely to the propeller-axis, and consequently obliquely to the drum, so that the metal of the drum, instead of sustaining a tensile strain, sustains an oblique strain, which is neither in the direction of the circumference of the drum nor at right angles to it, but in an intermediate direction, depending on the angle of the blade, or as the sines of the angles of obliquity of the blades.

To resist this cross-strain the drum must be made impracticably large, and if not made large enough to have sufficient strength for this strain, it is wholly useless.

In acknowledgment of this insufficiency of the band, Ericsson has patented what he calls oblique braces, additionally; that is, narrow braces placed between the blades in a direction at right angles to their surfaces, as indicated in fig. 2.

It will be observed that this is a very slight palliation of the evil, as it only braces the opposite extremities of two contiguous blades, and does not at all convey the excess of strength in the blade occupying the highest position to the one occupying the lowest position. It is apparent the slight benefit to be derived from this arrangement is not at all commensurate with the disadvantages of

Fig. 1.

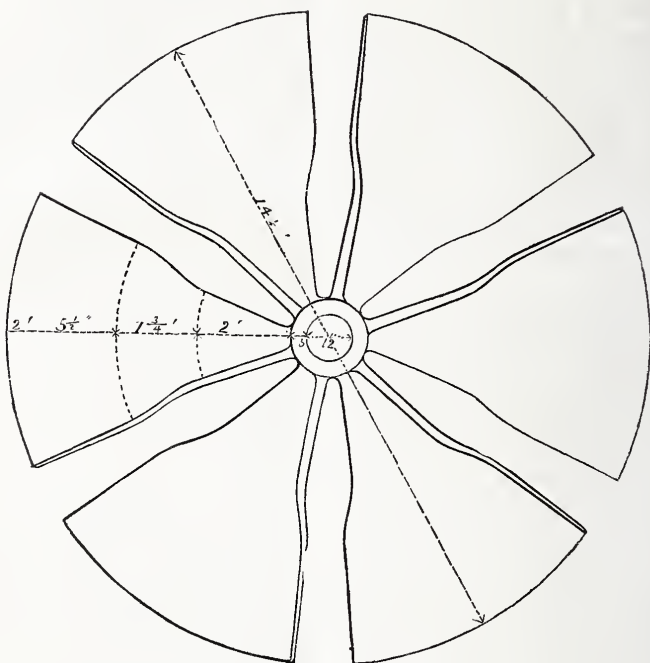
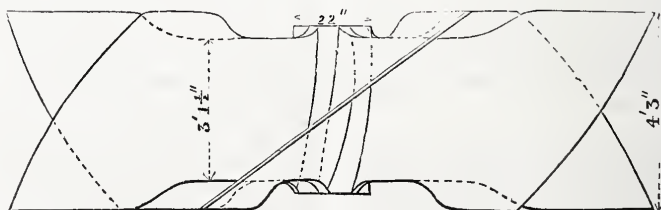


Fig. 2.



the friction of the surfaces of the braces and the direct resistances of their edges; not to mention their weight and cost. Common practice has shown, however, that there is no occasion for bands at all. Screw-propellers of 16 feet diameter are constructed with a thickness of blade at hub of about five inches, tapering to three-quarters of an inch at the periphery.

Cost of the "PRINCETON."

Materials—Construction, ..	\$44,233 49
Labor—Construction, ...	37,182 28
Materials—Equipment, ..	26,829 00
Labor—Equipment, ...	3,132 48
Machinery, ...	101,137 30
Total,	\$212,614 55

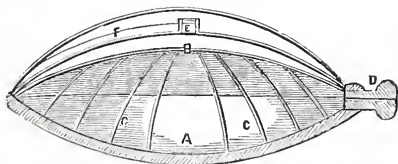
THE ANEROID BAROMETER.*

TORRICELLI's magnificent invention of the mercurial vacuum tube, as a measurer of atmospheric variations, is threatened with a rival of no mean importance, carrying with it the most overwhelming pretensions to simplicity, accuracy, and portability. The new, or rather the modern-antique, apparatus has received the title of "Aneroid," and has been twice patented in England, by M. Fontainemoreau, on behalf of the inventor, M. Vidi. The principle of the instrument is dependent upon the action of the atmospheric weight upon the exterior of an exhausted or partially exhausted case of thin metal, the top of which, being slightly flexible, is so contrived as to convey indications of the minutest changes in the atmospheric column to a graduated dial, upon which the readings are exhibited as in the ordinary wheel-barometer.

The results of M. Vidi's practical researches are given in the *Bulletin des Sciences*, tom. i., from which is the figure we have here engraved. The instrument bears a resemblance to a watch: it consists of a strong iron or brass box A, in the vertical section, fig. 1. To the edges of this box, a very thin and flexible steel cap B is fitted with great accuracy. cc are a series of springs, acting between the bottom of the box and its flexible top, so as to press the latter up. A small cylinder is fitted at D, by which the case, when exhausted, may be hermetically closed. The dial is placed im-

mediately over the top of the case, and is pierced in the centre for the passage of a central tube E, carrying an index-needle F, the whole being surmounted by a concave glass. It is obvious that if the space inclosed by the case is exhausted, the flexible top or cap B being acted upon by the unbalanced pressure of the atmosphere, will fall, and compress the supporting springs c; and the converse takes place when any diminution in the atmospheric pressure occurs. By simple mechanism placed in the tube E, this

Fig. 1.



movement of the cap may be communicated to the index-needle, which will thus register the variations in the columnar pressure. It is stated that the thermal changes of the atmosphere disturbed the action of the instrument, and eventually caused M. Conté to discard it as useless.

The objection of the want of any temperature compensation is a vital one, and it is this that M. Vidi has sought to remove in the aneroid of the present day.

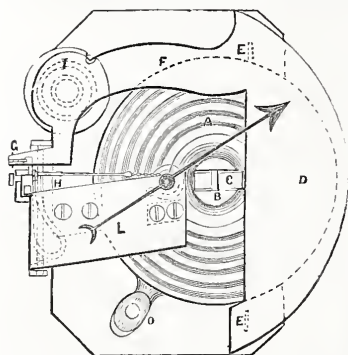
In the specification of the patent of April 27, 1844, it is stated that diaphragms of metal, glass, india-rubber, or other flexible, air-tight substances, may be used as the medium for receiving and indicating the barometrical changes. One of the great features which were introduced at this time was the circular corrugation of the flexible diaphragm—certainly a very happy idea, as it permitted of a great elevation or depression, without danger of rupture; and thus a larger and more available range of movement was obtained. The diaphragm was placed on the top of a circular flat-bottomed box, upon which were set a great number of helical springs, abutting against a number of annular disks on the lower interior surface of the diaphragm, thus diffusing their reactive force regularly over the delicate material.

A peculiar contrivance was resorted to for working the index-needle of the dial. A small cap of metal, projecting inwards

from the centre of the diaphragm, carries a nut suspended on a universal double ring-joint. This nut works upon a central screw-spindle, having very steep threads upon it; and as the diaphragm is elevated or depressed, the vertical movement of the nut acts upon the threads of the spindle, causing it to revolve and carry round the index-needle. This system of connection is at once unmechanical and liable to disarrangement, and in the later barometers it has been remodelled.

Our engraving, fig. 2, is a half-size plan of the instrument as now made, under the superintendence of Mr. Dent; fig. 3 is a corresponding side elevation. The vacuum chamber is represented at *A*; its top and bottom are formed of disks of

Fig. 2.



spindle carrying a lever *H*, connected to the arbor of the index-needle by a fine chain which winds upon it, like the main-spring chain of a watch upon the spring-box. In place of putting a set of reacting springs in the interior of the vacuum chamber, a single helix is fixed upon the base-plate, so as to abut against the lower surface of the lever at *i*, and thus preserve the two diaphragms of the chamber from actual contact.

To set the instrument to indicate the same scale as the mercurial barometer, the arrangement given full size in fig. 5 is adopted, to form the connection between the main lever and the index arbor. The link from the end of the main lever is jointed to an eye at *A*, on a stud formed upon the end of a metal bow-piece *B*, the contrary end of which is attached to

thin circularly corrugated copper, held together by a circumferential strip of plain metal, as shown in the detail, fig. 4, which is a vertical section of the chamber detached. A strong brass stud *B* is attached to the upper diaphragm of the chamber, having a slot on its end, through which a small projecting pin *c*, formed on the lever-plate *D*, projects, the attachment being effected by a pin passed transversely through the slotted portion of the stud, immediately over the pin *c*. The plate *D*, which acts as a lever in communicating the movements of the diaphragm, rests upon two pillars *E*, carried by the supporting base-plate of the vacuum chamber, as fulera. The projecting lever portion *F* conveys the movement by a joint at *G*, which is linked to a rocking

Fig. 3.

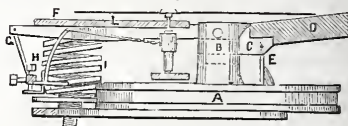
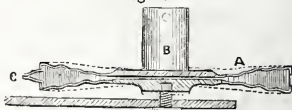


Fig. 4.

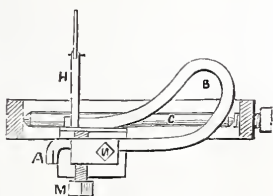


the lever *H*, before described. The whole of these parts are carried by a nicely adjusted rocking spindle *c*, working on centres in the frame *L*. The office of this contrivance is to afford a means of adjustment for the index movement by the two screws *M N*, one of which elevates or depresses the eye *A*, whilst the other sets it in or out from the centre of the rocking spindle, to give more or less leverage, as may be required to suit the barometrical scale. The connection between the index arbor and the lever apparatus being by a flexible chain, its movement can act only in one direction in bringing round the index, and a fine hair-spring is attached to give the return movement.

The tube by which the exhaustion is effected is at *o*. The process of exhaust-

ing, as specified by the inventor in connection with the original plan, is as follows: A little solder is placed round the aperture for the exhaust, in which a flat-headed pin is set, so open as to admit the air to pass. The diaphragm is compressed to its proper position by means of a board, and is then soldered to its box. The whole is afterwards placed under an air-pump receiver, having an air-tight stuffing-box, through which a rod, carrying the heated soldering-iron, is passed. When the vacuum is obtained, the soldering-iron is pressed down to melt the solder round the peg, and close the opening.

Fig. 5.



A simple mode of adjusting the instrument by a standard barometer is obtained by a screw-stud projecting through the back of the instrument, in connection with the reacting spring at *r*, the tension of which may thus be varied to the extent required.

Some journeys were lately made by railway from London to Dover with the aneroid, for the purpose of testing the results of the indications of the various levels. In a note given by the Literary Gazette, it is said that a singular disturbance of the index was observed between Folkestone and Dover, when passing through the tunnel, where frequent openings are made to the sea. On passing these openings, the index instantly moved $\cdot 025$, and then again resumed its original position, showing a momentary change in the atmospheric pressure. Strange to say, on the up journey no such vibration was perceived. Probably the speed of movement has something to do with this, as the up and down rates vary considerably.

James Glaisher, Esq., of the Royal Observatory, Greenwich, makes the following remarks in a letter addressed to Mr. E. M. Clarke:

"I have had several simultaneous ob-

servations made of the aneroid barometer and a standard mercurial barometer, and to my surprise and great pleasure, every change shown by the latter has as truly been shown by the former, almost in every instance to the hundredth of an inch. During the time of comparison, the barometer reading decreased from 29.5 in. on the 17th inst. to 29.3 in. at midnight on the 18th, and increased to 30.08 in. on the 21st, at which reading it continued for some time, and since then the reading has decreased. Finding the readings to agree so beautifully through this range, and to indicate so small changes of pressure, I have made some experiments with it with respect to different altitudes, and I find that it indicates the change of pressure of 50 feet very decidedly.

I have also made some experiments upon it with respect to the effect of temperature, and I find that for an increase of temperature of 10° , the readings increase 0.015 in., and this very evenly at all temperatures between 40° and 90° . It would therefore require an increase of temperature of 70° to cause the readings to increase one-tenth of an inch, owing to temperature.

Much mechanical ingenuity has been shown by the inventor, and he deserves great credit for this beautiful barometer. It is my opinion that it ought to supersede all ordinary barometers for domestic purposes, as being more accurate and more sensitive than they are, and also that it will be found to be of especial service on board of ships, being free from the objections which are made to the use both of barometers and sympiesometers at sea.

The effect of temperature is smaller than I expected it to be, considering the length of the levers, and of course it may be entirely neglected for all domestic purposes, but must be taken into account in its use at sea. The temperature correction ought to be determined for every individual instrument."

Mr. Glaisher has also furnished the annexed table of his comparisons with a standard barometer. The readings extend over a period comprised between the 12th of November and the 19th of December last, and the greatest error of reading will be found to be no more than 0.018 , the standard barometer being then at 30.039.

1848.	Hour of Reading.	Reading of Barometer Corrected, and Reduced to 32° Fah.		Error of Reading of Aneroid Barometer.
		Standard.	Aneroid.	
		inch.	inch.	inch.
November 12,.....	Noon.	30·421	30·418	—0·003
	9 p. m.	30·457	30·457	0·000
“ 13,.....	Noon.	30·468	30·470	+0·002
	3 p. m.	30·441	30·442	+0·001
“ 15,.....	3 p. m.	30·477	30·670	—0·007
	Noon.	30·325	30·311	—0·014
“ 16,.....	3 p. m.	30·320	30·317	—0·003
	Noon.	29·944	29·954	+0·010
“ 19,.....	Noon.	29·289	29·300	+0·011
	6 p. m.	29·201	29·207	+0·006
“ 22,.....	9 a. m.	29·198	29·196	—0·002
	Noon.	29·212	29·218	+0·006
“ 23,.....	3 p. m.	29·203	29·209	+0·006
	6 p. m.	29·220	29·230	+0·010
“ 25,.....	9 a. m.	30·119	30·109	—0·010
	Noon.	29·920	29·923	+0·003
“ 26,.....	6 p. m.	29·898	29·908	+0·010
	9 a. m.	29·836	29·826	—0·010
“ 27,.....	3 p. m.	29·969	29·960	—0·009
	9 a. m.	30·127	30·117	—0·010
“ 28,.....	Noon.	30·079	30·094	+0·015
	6 p. m.	30·039	30·021	—0·018
“ 29,.....	9 a. m.	29·974	29·975	+0·001
	3 p. m.	29·924	29·934	+0·010
“ 30,.....	9 a. m.	29·931	29·927	—0·004
	9 a. m.	29·397	29·400	+0·003
December 2,.....	6 p. m.	29·485	29·489	+0·004
	Noon.	29·158	29·165	+0·007
“ 3,.....	Noon.	29·308	29·302	—0·006
	9 a. m.	29·544	29·532	—0·012
“ 4,.....	Noon.	29·211	29·205	—0·006
	Noon.	29·890	29·891	+0·001
“ 7,.....				
“ 9,.....				
“ 19,.....				

Mr. Glaisher states that his original good opinions of the instrument have been fully borne out in all his later investigations, being “for all ordinary purposes superior to the common barometer, although, of course, not adapted for experimental inquiry.”

In the reduction of the readings which we have given, 0·044 has been subtracted for index error, and —0·0015 + (temp. 32°) for temperature correction, to bring them to the constant temperature of 32°. The correction for temperature was determined experimentally, and the same value was found to apply at all temperatures between 30° and 90°. The co-

efficient, as found at different times, from experiments separated from each other by a long interval of time, has remained unchanged.

By reference to the column of differences between the reduced readings of the two barometers, they will be found to be small, and to have different signs, and they are all within the error of reading the instrument, the mean of their values being quite insensible. A close examination of the table will show that during the period of observation the variations of reading were great, a great change frequently occurring within a very short time; but the whole of these changes

have been almost as clearly given by one instrument as by the other.

At the date of the observations, Mr. Glaisher had not satisfied himself as to whether the zero would change by moving from place to place. In our own opinion it is to be feared that it would. As in all attempts at the production of a substitute for the cumbrous mercurial instrument, the difficulty here has been the correction necessary for changes of temperature. Originally M. Vidi adopted what he terms a compound bow-piece as a compensator, and the confusion which has arisen from the fact of the doing away with this plan for a more accurate one, has involved considerable misunderstanding in the notes of different journalists who have attempted to handle the subject. The wonderful metallic bow-piece, of which so much has been said, is no longer used, and, by an arrangement as simple as it is beautifully correct, the vacuum-case is itself made to afford its own temperature correction, without the addition of a particle of mechanism. Previous to the exhaustion of the vacuum chamber, the top and bottom diaphragms are both perfectly horizontal; but when exhausted, they each take the curve shown in the section fig. 4, and the dotted lines represented as running nearly even with the corrugated surfaces indicate the position they will assume when a portion of gas is introduced to play the important part of a compensator for the disturbance to which the index would be liable from changes of temperature. The expansion of the contained gas, arising from the disturbing cause itself, counteracts the loss of elastic force produced by the same cause in the diaphragms and other parts of the machinery.

We are not told what the gas is, but we know from actual test that it does produce the desired effect to within an inappreciable fraction of mathematical truth, even when subjected to the severest changes of temperature. Calculation gives for atmospheric pressure upon the diaphragm, supposing the interior to be a practically perfect vacuum, about 70 lbs., whereas to elevate it requires only 40 lbs., as shown by a spring-balance; the difference is therefore due either to a simply vitiated vacuum, or to the introduction of an additional com-

pensating medium. To understand the action of this compensator, let us consider the main features of the instrument. The external atmosphere is continually endeavoring to press down the diaphragm, whilst the helix beneath the lever is as continually acting to keep it up. An increase in temperature expands the contained gas, which thus diminishes the effect of the external atmospheric pressure, and corrects the disturbance arising from the expansion of the various levers and connections, which would otherwise indicate upon the dial a greater amount of movement than is actually due to the atmospheric change.

We have tested its sensibility in various ways, by conveying it along the steep incline of the Glasgow end of the Caledonian Railway, and by the ascent of several flights of stairs. In each case, where the actual variation of the atmospheric column has been very slight, the index has faithfully recorded the fact; but we have not carried out our test so far as to check its exactitude by comparison with the real state of the case.

The advantages of portability and freedom from derangement are certainly completely secured in the aneroid; and we are persuaded that a few modifications, assisted by work of a more accurate character than that in the instrument before us, will bring the invention into extended use. The connections adopted for conveying the diaphragm movement to the index are crude, ill arranged, and badly made. Indeed, with such mechanism, it can hardly be said that the instrument has a fair chance of competition with the old class of barometers.

BUFFUM'S CENTRIPETAL GOLD AMALGAMATOR.*

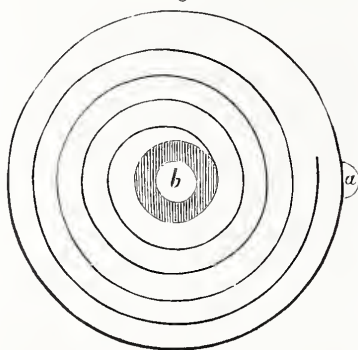
THE accompanying engravings represent an invention of Mr. Arnold Buffum, which has been secured by patent, and which is well spoken of by those who have seen it work.

Fig. 1 is a plan view of the bottom of the machine, and fig. 2 is a sectional elevation. The vessel resembles one of the vertical paddle churns. It has a raised rim on its bottom in the form of a coil, leading nearly from the entrance tunnel *a*, to the central opening or escape *b*,

* From the Scientific American.

in fig. 1. In fig. 2, A is the vessel or cistern, and B is a revolving rectangular paddle or dasher; c is a handle to give it a rapid motion by the bevel gearing D; the shaft is firmly secured at the sides in proper bearings; E is the vortex aperture, and F is the inlet spout. The gold sand or auriferous deposits are put in at the spout F, and the vessel is filled with water; motion is then given to the paddle B, when the water rises on the sides of the vessel, but the sand passes from the circumference to the centre, into the escape channel E.

Fig. 1.

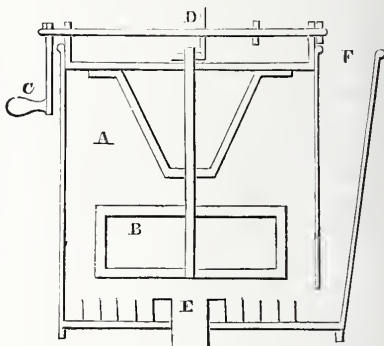


large per centage of the gold passes off with the sand. None of them are so arranged as to give the necessary action to the water to carry off all the impurities, so as to keep the quicksilver bare and clean for the absorption of the gold; and in all of them the operations are such that, with heavy iron sand, the quicksilver gets broken into globules, so that much of it is lost.

It is a mistaken idea that gold invariably unites with quicksilver immediately on coming in contact; on the contrary, it often passes in a current of water a distance of several feet on the surface of quicksilver, before a sufficiency of the quicksilver adheres to the gold to bring it into amalgam. An amalgamator for the fine scale gold in crushed quartz or in black iron sand, to be complete in its operation, must present a surface of quicksilver on which the compound passes in continuous contact, for a distance of not less than six or eight feet, and for rapid operation the

It is uniformly conceded that, in the amalgamators now in use in all the gold mining regions in the world, there are faults which it is very desirable should be obviated; in those where rocking or shaking is relied on for floating the sand and washing it away, the quicksilver is constantly changing its position, and leaving parts over which the golden sand is passing, with no underlayer of quicksilver to absorb the gold; and in those to which this objection does not apply, the distance over which the sand passes in contact with the quicksilver is so short, that a

Fig. 2.



distance must be proportionally greater, and the power of the current must be such that every thing which does not settle into the quicksilver will be washed away.

To construct a mechanical arrangement for this purpose, in such a manner as will most perfectly accomplish its design, the inventor must understand the philosophy and action of centrifugal and centripetal forces when applied to fluids; for, by a proper combination of these forces, the necessary action is brought to bear over such an extended distance on the surface of quicksilver, as to secure, at one operation, the amalgamation of all the gold, wash away all other substances with rapidity and ease, and lose none of the quicksilver.

An application of momentum to fluids moving in a circular direction, gives centrifugal force; and on this basis, scientific writers have asserted that a whirlpool of water must carry every thing that is dependent on its momentum from the

centre; this is an error resulting from an oversight of the fact that the centrifugal force in a whirlpool, confined within certain limits, as in a cistern, is greater on the upper surface than it is at the base. In a whirlpool produced by a horizontally revolving paddle in a stationary cistern, the centrifugal force throws the water from the centre and piles it against the sides of the cistern, forming an inverted hollow cone. The centrifugal force increases the elevation at the periphery, until the weight of the pile overpowers the centrifugal force at the base; the water continuing to go out from the centre on the upper surface, on reaching the periphery, sinks downward to the bottom, forcing that which was there before it to the centre, to be returned on the upper oblique surface to the periphery, making between the centre and the periphery a continual spiral movement, in the direction of the thread of a screw-bend horizontally to a circle. The momentum imparted by the circular movement of a whirlpool to a solid substance on the bottom of a cistern, gives to the substance a centrifugal tendency, but the centripetal pressure of the water, from the elevated periphery of the whirlpool, is more powerful than the centrifugal force imparted by its circular motion, and consequently the solid substance is carried with the water spirally to the centre.

A practical familiarity with these facts, in direct opposition to the theory of scientific writers, has resulted in the construction of a very simple mechanical arrangement, consisting of a long quicksilver holding-channel, coiled spirally on the bottom of a cistern, commencing at the periphery and ending at the centre, with a horizontally revolving paddle, suspended above the channel in the cistern. The feed of auriferous compound, commingled with water, is received into the cistern at the base of the periphery; the revolving paddle keeps the water in a rapid whirlpool motion, which carries the auriferous compound in the channel on the surface of the quicksilver, until the gold is all united in amalgam, and the soil is discharged through an aperture at the centre of the cistern bottom. When the whirlpool is in operation, the centrifugal force gives a permanent support to the inverted hollow cone form of the whirlpool, in which the revolving paddle

obstructs the escape of the water, by throwing it from the aperture at the centre, forward, outward, and upward to the periphery; when it reaches the periphery it sinks downward to the base, where by the force of pressure it produces a centripetal movement, in harmony with the centripetal direction of the spiral channel.

If the mechanical arrangement were reversed, so as to receive the compound at the centre and discharge it at the periphery, the centrifugal force would throw the fine scales of gold outward and upward on the oblique surface of the whirlpool to the periphery, where it would pass off without any contact with the quicksilver, but its reception at the periphery brings it into the whirlpool, where the movement of the water is downward, circular, and centripetal, so that a continued contact of the gold on the surface of the quicksilver is sure, from its entrance until it sinks in amalgam.

Machines constructed upon the principle set forth, according to their various sizes, are adapted for quartz mining, and for separating the gold from the black iron sand; the invention is a harmonious combination of mechanical devices, using the force applied to generate motion in two directions, generally called forces—centripetal and centrifugal—which, in this instance, perform a beautiful operation in a direction inverse to common opinion. This machine may be seen in practical operation at No. 25 Cortlandt street, this city, where information may be obtained of the patentee, Mr. Buffum, respecting it.

MECHANICS FOR THE MILLION, NO. VIII.

Continued from page 677.

TRANSMISSION OF WORK BY SIMPLE MACHINES.

25. THE object of machinery, properly so called, is to regulate the distribution, or change the direction of work—not to increase it. If there were no friction or any other resistances to the motion of the pieces composing a machine, the work that would be given out would be exactly equal to the work applied. Dead matter, by its gravity, produces pressure, and by the intervention of mechanism that pressure may be increased or decreased, but *work* is peculiarly the pro-

duction of active or living agents. To suppose that machines are capable of augmenting work, would be endowing inert matter with a creative power—the power of creating work. It is true that man, in a certain sense, creates work by mechanical combinations, when he turns the mountain stream to drive a wheel, or to form a canal; but here the true source of the work is the heat of the sun. In all instances of labor performed by inanimate matter, there is some active agent of nature, such as heat, electricity, or gravitation, which gives rise to the work; but in the case of merely mechanical arrangements, the inert matter is the passive recipient of work, or the channel through which it flows: hence we may lay it down as a fundamental axiom in mechanics, that (abstracted from friction and the resistance of the air) *the work done by any machine is the same as the work applied*. Now as the work is the product of pressure and motion, it follows that if the working point of a machine moves more slowly than the driving point, then the pressure at the former will be greater than it is at the latter.

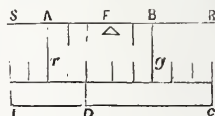
The Lever.

26. Let PW , in the annexed diagram, be a rod or lever, turning upon the fulcrum or centre F ; P and w are weights which balance each other, or maintain the lever in equilibrium; then when this is the case, $P \times PF = w \times WF$, that is, the units of weight in P multiplied by the units in its distance from F , will be equal to the units of weight in w multiplied by the units in its distance from F .

Here P is called the power, and w the weight or resistance, and a mechanical advantage is gained, inasmuch as a small weight or pressure is used to balance a large one. The product of any weight by its distance from the centre of motion, or fulcrum, is called the moment of that weight, and therefore when the sum of the moments tending to turn the lever in one direction is equal to the sum of the moments tending to turn the lever in the opposite direction, then the lever will be in equilibrium. This is a particular case of the principle of the equality of moments.

Proof.—Suppose two uniform bars, ID

and DC , in the second diagram, to be suspended from their centres r and g , by means of cords attached to the points A and B of the lever SR , turning upon the



fulcrum F , which must evidently be in the middle of RS , or over the middle of IC , in order to secure equilibrium. Let the weight of the bar $ID = 4$ lbs., and the weight of $DC = 6$ lbs., then ID will contain four units of length, and DC six of these units. Now it is obvious, from the figure, that AF , the distance at which ID acts from the fulcrum, will contain three units, and BF , the distance at which DC acts from the fulcrum, will contain two units; then, since it appears that a weight of 4 lbs., suspended at A , balances a weight of 6 lbs. suspended at B , we therefore have the following relation when equilibrium takes place:

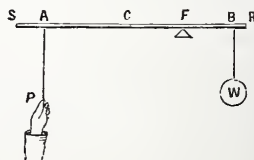
$$4 \text{ lbs.} \times 3 = 6 \text{ lbs.} \times 2, \text{ that is,}$$

$$\text{Wt. at } A \times AF = \text{wt. at } B \times BF.$$

In precisely the same way the proposition may be established for any other case.

Lever is divided into three kinds:

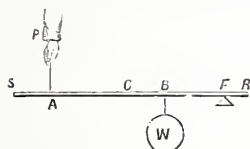
First kind of Lever.—The power and weight are on opposite sides of the fulcrum. In the accompanying diagram,



SR is the lever, F the fulcrum or centre of motion, P the power acting at A , and w the weight attached to the point B . A crowbar, a claw-hammer, the handle of a common pump, a pair of scissors, a fire-poker, &c., belong to the first kind of lever. And in all these instances a mechanical advantage is given to the power, whenever the arm AF by which it acts is longer than the arm BF by which the weight acts. Thus, if AF is twice BF , the advantage gained will be 2, that

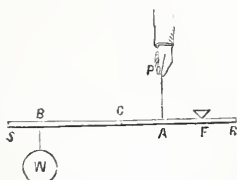
is, 5 lbs. at A will balance 2 times 5 lbs. or 10 lbs. at B. Thus, if AF is 3 times BF , the advantage gained will be 3; that is, 7 lbs. at A will balance 3 times 7 lbs. or 21 lbs. at B. Or generally, as many times as AF is longer than BF , so many times will w be greater than P . This immediately results from the principle of equality of moments given in the preceding paragraphs.

Second kind of Lever.—The weight is between the fulcrum and the power.



Here w is the weight, F the fulcrum, and P the power. The oar, nut-crackers, the bread-knife, the rod of a safety-valve &c., belong to the second kind of lever. And in all these instances, a mechanical advantage is given to the power in the same way as in the lever of the first kind. Thus, if AF is 3 times BF , the advantage gained will be 3; therefore, a force of 4 lbs. applied at A will balance a weight of 3 times 4 lbs. or 12 lbs. at B.

Third kind of Lever.—The power is between the fulcrum and the weight.



Here P is the power, F the fulcrum, and w the weight. The fire-tongs, the sheep-shears, the limbs of animals, &c., are instances of the third kind of lever. Here the power must be greater than the weight, because the distance AF , at which the former acts, is less than the distance BF , at which the latter acts.

Ex. 1. Let $w = 80$ lbs., $wF = 3$ inches, and $PF = 16$ inches; required P . See fig. Art. 28.

Here, by the equality of moments,
 $P \times 16 = 80 \times 3$, $\therefore P = \frac{240}{16} = 15$ lbs.

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Ex. 2. Let $w = 90$ lbs., $wF = 4$ inches, and $P = 15$ lbs.; required PF .

$15 \times PF = 90 \times 4$, $\therefore PF = 24$ inches.

Ex. 3. A man exerts a pressure of 80 lbs. upon a crowbar, at a distance of 4 feet from the fulcrum; what weight will he balance at the distance of 4 inches from the fulcrum?

$w \times 4 = 80 \times 48$, $\therefore w = 960$ lbs.

Or thus: In this example, the leverage of the power is 12 times the leverage of the weight, for 4 feet are 12 times 4 inches; therefore w will be 12 times P , that is, $w = 12$ times 80 lbs. = 960 lbs.

Ex. 4. In a lever of the second kind, $w = 20$ lbs., $BF = 5$ inches, and $AF = 25$ inches; required P .

Here $P \times 25 = 20 \times 5$, $\therefore P = 4$ lbs.

Ex. 5. In a lever of the second kind, $P = 6$ lbs., $w = 72$ lbs., and $BF = 3$ inches; required AF .

$6 \times AF = 72 \times 3$, $\therefore AF = 36$ inches.

Ex. 6. In a lever of the third kind, $w = 28$ lbs., $BF = 20$ inches, and $AF = 7$ inches; required P .

$P \times 7 = 28 \times 20$, $\therefore P = 80$ lbs.

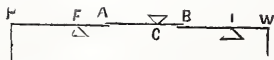
Ex. 7. In a lever of the first kind, 5 and 8 lbs. are placed on one side of the fulcrum, at the distances of 4 and 2 inches respectively from the fulcrum; required the power P , acting at the distance of 12 inches from the fulcrum, to maintain equilibrium.

The efficacy of the 5 lbs. to turn the lever will be its weight multiplied by its leverage, or 5×4 ; and the efficacy of the 8 lbs. to turn the lever will be its weight multiplied by its leverage, or 8×2 . Now the sum of these two moments, or tendencies to turn the lever, will be equal to the moment of P , or $P \times 12$, tending to turn the lever in the opposite direction.

$\therefore P \times 12 = 5 \times 4 + 8 \times 2$; $\therefore P = 3$ lbs.

Ex. 8. In a combination of three levers of the first kind, the long arms PF , AC , and BI are 9, 10, and 12 inches respectively, and the short arms FA , CB , and IW are 3, 2, and 4 inches; if a pressure of 5 lbs. be applied at P , what weight will be supported at w ?

Here in the lever PA , the pressure pro-



duced at $A = \frac{6}{3} \times 5 \text{ lbs.} = 15 \text{ lbs.}$ In the lever AB the pressure produced at $B = \frac{1}{2} \times 15 \text{ lbs.} = 7.5 \text{ lbs.}$ And in the lever BW the pressure produced at $w = \frac{1}{4} \times 7.5 \text{ lbs.} = 1.875 \text{ lbs.}$

Ex. 9. Required w , as in *Ex. 3*, when the pressure of 60 lbs. is exerted at the distance of 6 feet from the fulcrum, and the weight w is at 3 inches.

Ans. 1440 lbs.

Ex. 10. What is the mechanical advantage of the lever in the last example?

Ans. 24; because the weight is 24 times the power.

Ex. 11. In a lever of the second kind the power acts at 5 feet, and the weight at 2 inches from the fulcrum; required the power necessary to balance a weight of 4 cwt.

Ans. 14.9 lbs.

Ex. 12. At what distance from the fulcrum must the pressure in *Ex. 3* be applied, so as to support a weight of 5 cwt.?

Ans. 28 inches.

Ex. 13. In a combination of three levers of the first kind, the long arms are 2, 3, and 5 feet respectively, and the short arms 4, 6, and 2 inches respectively; if a pressure of 8 lbs. be applied, what weight will be balanced?

Ans. 3.8 tons.

Ex. 14. In a lever of the first kind a weight of 4 lbs. is placed at the distance of 3 inches from the fulcrum, and on the same arm another weight of 7 lbs. at the distance of 5 inches; where must a pressure of 3 lbs. be applied to balance the lever?

Ans. $15\frac{2}{3}$ in. from the fulcrum.

Ex. 15. Let PF and WF be the arms of a false balance, a certain weight Q weighs 16 lbs. when put into the scale attached to the long arm, and only 9 lbs. when put into the opposite one; required the true weight of Q .

Here, by the equality of moments, we obtain two equations,

$$Q \times PF = 16 \times WF; \quad Q \times WF = 9 \times PF.$$

Multiplying these equations together, and then striking out the common factors, we have

$$Q^2 = 16 \times 9, \therefore Q = 12 \text{ lbs.}$$

(To be continued.)

For Appletons' Mechanics' Magazine and Engineers' Journal.

CROTON AQUEDUCT—SUPPLY OF WATER TO BLACKWELL'S ISLAND BY MEANS OF GUTTA PERCHA PIPE.

THE conveyance of water by pipe laid across the bed of a stream is no novelty, and in many cases it is attended with no difficulty. In the work, however, above referred to, both the material selected for the conduit and the obstacles encountered, lead me to suppose that a detailed description of the operation may not be entirely uninteresting to all your readers. Experience teaches as well by failures as successes, and in a notice of this kind the professional reader has a right to expect details of both.

In December last the proper preliminary examination having been made, it was determined to supply Blackwell's Island with Croton water to the amount necessary for 5000 inhabitants. The island is situated just below Hellgate, the upper or northern end of it reaching the southern limit of that far-famed pass. The water thus divided by the island rushes past it in two deep channels, with a tide little inferior in power to that of the most dangerous parts of "the Gate" itself. For the entire length of the island, the centre-depth of the channel next to the New York shore is from 70 to 75 feet, with a rock bottom. The range of the ledges of rock is in a line with the flow of the tide, while the rift being nearly perpendicular, the wearing away of the rock has caused the bed of the stream to be exceedingly irregular; the transverse soundings showing profiles singularly uneven and abrupt in their rise and fall. It was on such a bottom and in such a tide that the pipe was to be laid. At the point selected the channel is about 900 feet wide, and the depth of water in the line of crossing varies from 55 to 75 feet, the bed of the stream falling off boldly and attaining the former depth within a short distance from either shore. The difficulty and expense attending the laying a leaden pipe in such a location induced the trial of gutta percha pipe. By all that could be yet ascertained in reference to this comparatively new material the experiment was warranted, and a contract was accordingly made for the manufacture of the pipe. When it was delivered, however, and sub-

jected to test, it was found to be inferior in its strength to that guaranteed by the contract. It was warranted to sustain a pressure of 300 pounds to the square inch, the proof to which the cast-iron pipes for the Croton are tested, whereas on trial it was found to be unable to bear more than 180 pounds. On close examination it was found that the deficiency in strength resulted from the mode of manufacture, not from the nature of the material. Unlike lead-pipe, it had not been made without a seam. The material used for the core had been fixed to its place in the cylinder by means of a bridge. This bridge had divided the material into four parts just at the entrance of the die. Between this point and the end of the die whence the completed pipe issued, the distance was too short and the material too cool to allow a perfect cohesion of the parts separated. The confidence of the engineer in the strength of the *material* itself if formed *properly* into pipe, was not at all impaired by the tests to which at this time it was subjected, but on the contrary was increased. The manufacturers here proposed that if the condemned pipe could be laid down for six months no charge should be made for it, and they would bind themselves to produce, before the expiration of that period, pipe without a seam and of double the strength required by the contract. So good an opportunity of making an experiment both as to the method of putting the pipe in its destined bed, and of its durability after being there, was not to be lost. The proposition of the manufacturers was accepted, and the preparations for putting it down were completed. The operation to be performed could only be done during the few minutes of comparatively slack-water, the extraordinary tide making at other times any work impossible. The slack-water varies here from one minute to seven minutes, and the interval between the tides, including the slack, when from comparative cessation of current, work can be prosecuted at all, varies from five minutes to 20. During this time the pipe was to be run across the river from shore to shore; anchors for sinking and holding in its bed put on every joint, lowering lines attached from the several boats and the pipe lowered to its place by movements so graduated that the whole

line of it, conforming to the profile of the bottom, should reach its bed at the same moment. This method of lowering was adopted to secure an object considered of vital importance—perfect and continuous contact with the bottom, considered necessary in order to prevent the high projecting points of the rock from chafing the pipe by the vibratory action of the tide, in the event of its hanging suspended between two points of rock. The arrangements and mode of operation were as follows: A line of 12 large yawl boats* was stretched across the river and held by stem and stern anchors, at certain points designated on the profile of the bottom. Thirteen other boats were stationed near the shore, the men ready to pull to their respective posts as soon as the order was given. Each of these 25 boats was provided with an anchor to attach to the pipe, with a strap to hold the pipe during this operation, and a lowering-line for letting it down in its place. Six other boats, with all the rest of the anchoring weights divided among them, lay also in shore ready for orders. The pipe, in one continuous length of 1100 feet, was ready on the Blackwell's Island shore, and a coil of rope, one end of which was attached to it, placed in a well-manned and swift boat. As soon as the tide would permit the crossing, this boat started for the opposite shore across the sterns of the anchored boats. As the boat struck the opposite shore the rope she carried was immediately manned by a sufficient number of men stationed there, and aided by those who manned it on the island, the pipe was rapidly drawn across the river. Meanwhile the waiting boats had taken their respective stations, so that the moment the pipe was stretched on the surface from shore to shore, the straps were passed round it to suspend it to the 25 boats in line—all the anchors put on the lowering-lines attached, the straps again cast off and the pipe lowered to its bed by two separate movements—the first to bring it in a line of suspension con-

* As an evidence of the power of the tide here when at its greatest velocity, it may be mentioned that of the line of boats which were first anchored across the river, although of great capacity and with very great scope of cable, all those which were near the centre of the stream were drawn under by the force of the current and swept from their moorings. Two of these boats were each of them 50 feet in length by 20 in breadth.

forming to the bottom of the river; the second, to lay it upon every point of its bed at the same time. From the moment when the first boat started from the island until the work was finished there elapsed 17 minutes. During this time, besides the other necessary work, about one hundred anchors were attached to the pipe. Apparently the work was thoroughly performed, and had it not been for an untoward accident it would have been. A large vessel, disregarding the signals and sentinels which had been placed to prevent all craft from taking this channel, bore directly across the line at the moment when the men were engaged in attaching the anchors—greatly endangering the lives of those in its course. The result was some confusion, and the consequent failure of one of the men to put on all the anchors at his station. This was not known at the time—the tide was now making rapidly, and the order was given to lower. This was at the end of December last. The pipe performed its work very well until the beginning of June following, when, failing to supply the island with water, it was taken up to ascertain the cause of failure. It was found that at the point above mentioned several anchors had been omitted, leaving nearly fifty feet of the pipe subject to the vibratory action of the tide. The constant abrasion against the sharp rocks at the bottom, consequent upon this, had of course chafed the pipe through at one or two points in the space thus unprotected. Except in these points it was comparatively uninjured by abrasion. The rest of the pipe was now subjected to tests, and found to have undergone no perceptible chemical change whatever. Being again proved by the hydraulic press, it stood as much pressure as it did before it was put down. Being convinced, by the winter's experience, of the durability of the material and the advantages it presented in a location like this, and being satisfied that by another method of putting it down all chance of the recurrence of such an accident as the one above described could be obviated, it was determined to use this same kind of pipe again. The improvements during the winter in the machinery for making it had by no means equalled the engagements of the manufacturers. They had

not succeeded in making it without a seam, and the pipe now presented for trial, although, owing to a slight improvement in the mode of manufacture, somewhat stronger than that which was first made, was much too weak to bear the pressure specified in the original contract. Still the first and weaker pipe had, as proved by experience, borne all the pressure to which it would be subjected in that position, and the peculiarities of the locality seemed also to urge the adoption of the same material again.

This second line of pipe was furnished about the 20th of September, and put in its place on the 26th of the same month. To avoid accidents like the one which had rendered imperfect the work of last December, the mode of operation now adopted was different. The pipe being all put together in a continuous length, as before, was attached to a line of large boats, which was stretched down the stream, and along the shore of Blackwell's Island, in the eddy, but in water of sufficient depth to make the proper arrangements for subsequent operations. These boats were stationed at such intervals that the slack of the pipe between them properly graduated, would conform to the inequalities of the bottom in the line of the destined position of the pipe, the boats themselves being kept in place by being made fast to a hawser 1150 feet long, drawn taut between heavy anchors at the ends of it. The anchors at the upper end were at the point at which the pipe was intended to connect with the Island. The anchors to hold the pipe down were now put on thoroughly, the workmen not being subject to the strength of the tide or danger from sailing craft. As a further precaution against abrasion, both the number and weight of the anchors was increased. Those now put on were but five feet apart instead of nine feet; and the weight of each one was 34 instead of 28 lbs. The line being thus prepared, a steam tow-boat, properly fitted with bitts in the stern, was made fast to the hawser, at a distance from its upper end equivalent to the width of the river. Just before the slack of the flood-tide, the lower end of the hawser was cut loose from the anchor which had kept it stretched, the end taken on board the steamboat and made fast to the bitts, and the move-

ment across the river commenced. The hawser, notwithstanding the weight of anchors upon the pipe, was still kept extended by the power of the steamboat, and the whole line swung round on its centre, until it stretched across the river to the New York shore; when the steamboat was sufficiently near the proper point on that shore, the bite of the hawser was run ashore by a heaving-line, slipped into a large snatch-block (which had been previously attached to the solid rock just above high-water mark), the rest of the bite cast loose from the steamboat, and she getting again under headway, the hawser was drawn taut through the snatch-block, and every boat was brought up in a perfectly straight line. From the bows of this line of boats the pipe now hung immediately over its destined bed. The line which suspended it to each boat passed over a chopping-block—a man stood by with a hatchet, and when the word was given, a single blow from each man let the pipe drop to its place. There is but little doubt that it is properly placed, and but little fear that it will fail. It perhaps may be as well to mention here, that the first attempt to put down the pipe in this manner failed. The power of the steamboat was, of necessity, applied in a direction tangent to the arc, which she would describe while performing her work. The difficulty of doing this, while so great a weight at her stern was counteracting the power of the rudder, was found to be much greater than was anticipated, and the ebb-tide making when the steamboat had reached about half way across the river, she, together with the entire line of boats, were swept back to the shore whence she had started. The operations at the slack of the flood-tide next day were successful, and the time occupied was twenty minutes.

Previously to taking up the first pipe from its bed, a diver had been employed to examine whether the plan adopted for insuring a continuous contact with the bottom had been successful. His submarine dress and apparatus were excellent, and enabled him to make a thorough examination. The result of it was most satisfactory, every portion of the pipe having been found in close contact with the bottom.

From this experiment, partly induced by a desire to obtain professional knowledge of a new material, partly forced by the difficulties of the locality, such results as have been determined may be considered satisfactory. Its flexibility and lightness, and the consequent ease and economy in handling it, certainly proved great advantages in the work here detailed. Its specific gravity is about .98, and its flexibility sufficient for its close adaptation to a very uneven and irregular bed. Under the hydraulic press, also, the pipe was found to be slightly elastic, and to this may be attributed the success with which the test-line bore the pressure to which it was subjected during the winter. The pressure of the Croton at this point is (in a state of rest) about 45 lbs. to the square inch; but in view of the sudden strain often occasioned by the too rapid shutting down of a stop-cock, the iron pipes are always subjected to a test-pressure of 300 lbs. During the winter, a stop-cock, on the lower end of the Island, was broken from this cause, although it had previously born the test-pressure—while the gutta-percha pipe, which under the test had not been able to sustain a *continued* strain of more than 180 lbs., bore without rupture the same shock. This is owing directly to its elasticity—the shock was but momentary, and the material yielded sufficiently for its protection. Its toughness and cohesiveness, when properly worked, proved, under various tests to which it was subjected, to be wonderful. Of its great durability while used in this manner, chemists who have examined the pipe which has been taken up, speak most favorably and confidently.

The gutta-percha pipe used was three inches in diameter—the material being $\frac{3}{8}$ inch thick, and made in lengths of 9 feet. The joints were made as follows: the end of one length was pointed off, and partially roughened on its surface with a hot rasp; the end of another piece was made flexible by being heated in hot water, then opened by the hand sufficiently, and carefully dried. The pointed end being inserted, and the other closed around it by the pressure of the hand merely, and being suffered to get cool, the junction became perfect, and the whole pipe essentially one piece. c.

STEAM-CARRIAGE FOR PLANK-ROADS AND
SMOOTH PAVEMENTS.—IMPROVEMENTS
BY J. K. FISHER.

Continued from page 663.

In the description of Mr. Fisher's improvements, given in your last number, we confined ourselves to the working of carriages for passengers for hire. We now propose to view it as it was originally intended, as a private carriage, designed for convenience, comfort, elegance, and economy.

The expense of keeping horses is considerable, especially to those who use them only for riding, and would not wish to keep men-servants, were it not exceedingly unpleasant to take care of even a single horse, and to be in some measure obliged to be at home at inconvenient times, lest he should suffer for want of food. The wealthy may not feel the force of this; but the man of slender means, who wishes to enjoy the quiet frugality of a rural home, and to go with comfort, at his own convenient hours, to and from his business in the city, is but too painfully aware of the burdensomeness of man and horse; and rather than support them, he submits to the set times of the public conveyance, with all its disadvantages and discomforts. How far steam can furnish a remedy for these deficiencies may be judged from the following description:

It is obvious that the end proposed could not be attained, unless the fire, the boiler, and all the machinery, could take care of themselves after being supplied with fuel and water for a reasonable distance, of ten or twenty miles: accordingly, Mr. Fisher sought the most efficient means of securing a performance by the machine itself of all the necessary functions which the engineer, with his gage-cocks, breaks, and levers for retarding, stopping, backing, and his fire-irons, manages to accomplish, with great toil, when his eye should be constantly upon the road, to see the danger before it should be too late. The first step was, to make the fire self-feeding. This is accomplished by a hopper or reservoir in the upper part of the furnace, from which the fuel settles down into the fire as it burns away at the bottom, somewhat as it does in Perkins' hot-water heating apparatus; so that when you

stop at a tavern, instead of feed and water for your horse, you will order your hopper and water-tank to be filled, and have no further trouble about it.

To insure a rate of combustion which at least should not slacken when the resistance increased, from ascents or bad roads, is of importance. But to do this by simple and cheap means is not easy. The blast-pipe is the universally favorite mode in locomotives; and its simplicity and cheapness as to first cost cannot be surpassed. But the noise, the sparks and dust, and the back-pressure caused by it, are insuperable objections to its use: taste will not endure it, and science will hardly tolerate it much longer. We have at this moment before us a late number of the *London Practical Mechanics' Journal*, in which an eminent engineer, Mr. Sharp, of Swinton, writes, "In the locomotive, if the pressure of steam on the acting side of the piston be 100 pounds per inch, a resistant pressure of 40 pounds or more will be found on the other, thus nearly half the power is expended in expelling the steam from the cylinder. It may be said that this arises from the blast-pipe; and no doubt to a certain extent it does; but the valve-openings are not promptly opened," etc. Instead of this barbarous mode of blowing the fire and frightening horses, Mr. Fisher adopts the fan, which is in general use in steamboats; and to insure a constant and regular action of it, he applies a small separate engine, which also works the pumps, and thus leaves the main engines free from the rods and levers necessary to work them. This small engine may be made to work at any speed required, so that when the road is bad a reasonable rate of travel may be kept. And we may here remark that one of the usual arguments against working expansively, is that too little steam will be used, and the blast will not be forcible enough; so we must have a large boiler and use abundance of steam to get an efficient combustion by this mode if this opinion be correct. And finally, the fan, worked by a small engine, will take care of the fire when the carriage is standing—the throttle-valve and damper being adjusted by the pressure of the steam—so that the carriage may be left for an hour and still be ready to start.

The feed of water is regulated by a

float, operating in a novel way, which appears likely to be effective.

One thing more was wanting, a self-adjusting cut-off; it would be too troublesome, in a pleasure-carriage, to watch the quality of the road and the steam-gauge, and to adjust the cut-off at every change of resistance. This adjustment, so essential to economy, is performed by a very ingenious mechanism, which some regard as too delicate for the jolting of a road; but we believe it will work well; and if it fails at any time, the adjustment by hand can still be effected.

The steersman, being relieved of all care of the machinery, has only to manage the steering-lever, and to let on the steam, or throttle it, or reverse, according as he wishes to run fast or slow, or to stop. All this is done by a valve, worked by a hand-lever. The English carriages were provided with cumbersome drags and breaks, to diminish their speed down hill, and to stop them; and the working of these appendages was a severe labor; but all the effect of them can be produced by the steam itself, when let on the reverse way, with the required pressure. The stopping is the most difficult operation, at a high speed; but at a moderate speed it offers no difficulty. The valve may be instantly thrown the reverse way, and the steam will, with its whole force, resist the forward motion of the pistons, and be pumped back into the boiler; and, when the speed is five miles per hour the carriage will stop in five feet; at ten miles per hour it will stop in twenty feet; at fifteen miles it will stop in forty-five feet; and at the usual rate allowed in cities, eight miles, it will stop in thirteen feet from the instant of turning the lever. This, we think, is as quick as horses can be stopped upon pavements.

The carriage may be steered from within, so that one need not be exposed to the weather. And, in the winter, the waste steam may be used to warm it, in the manner it is used in buildings; and with no other expense than a thin coil of pipe.

The time required to get up steam is very little. Mr. Bramah tried, with one of Gurney's carriages, and found that in eight minutes after applying the match the steam was at full pressure. And

when charcoal is used the firing may be more rapid. The labor of lighting the fire is the same as in a common stove, and may be reduced to almost nothing if the kindling materials be properly prepared and done up in the form of cartridges. And as such a carriage could be kept in the house, for the convenience of getting in and out without exposure to the weather, it would be no objectionable task for a female-servant to kindle the fire and supply the tank with water.

It is supposed, by many who have formed their notions of steam-carriages upon common locomotives, that horses would be frightened by them, that steam and smoke would issue from them, and that they would be noisy. But, from the evidence given before the committee of the House of Commons in 1831, it appears that horses took very little notice of them; that as they burnt coke, no smoke was made; and that the steam was mixed with the gas in the chimney, and superheated so as to become invisible. And by giving a proper shape to the exhaust-pipes, and covering them with materials that are not sonorous, the noise may be done away with, as it often is in stationary engines. In short, it may be said, as the general result of that testimony, that steam-carriages make no more noise than other carriages, and that since the noise made by the horses' feet is entirely avoided, they are far more quiet than any others.

The comparative expense of a one-horse carriage, and such a steam-carriage as we described in our last, will be: for a speed of ten miles per hour, running thirty miles per day:

	Value of horse,	\$300
Value of machinery,	\$600	carriage, 300
" " carriage,	400	harness, 30
	\$1000	\$630

The deterioration of the horse and wheels and harness will be greater than that of the machinery; but assuming it equal, at 10 per cent., with 7 per cent. interest, we have 170 dollars per year for the steam-carriage, and 107 for the horse-carriage. The current expenses will be, for fuel, 30 pounds per day, \$27 40, and for oil, say 10 dollars; making in all \$207 40; and for the horse-keeping, at

2 dollars per week, 104 dollars : shoeing 15 dollars, in all 226 dollars. The feed and stable-rent near a city will cost at least two dollars per week ; then add the value of the service of taking care of the horse, at the lowest estimate, 26 dollars ; and allowing the trouble of getting up steam, and wiping and oiling the engines, to be equal to that of harnessing, and we find that the steam-carriage, of four-horses' power, capable of running thirty miles per hour, costs forty-four dollars per year less than a one-horse carriage, which can run but ten miles per hour, and carry but half the load. And if a long journey is to be taken, the horse cannot do it at any useful speed. The increased way-expenses consequent upon his slow movement would amount to more than the total expense of the steam-carriage. Suppose you wish to go three hundred miles, you can do it in one day by steam, at a cost of a dollar for fuel and oil, and a dollar for each passenger for way-expenses ; but the horse will require ten days to do it without injury to him, and the way-expenses will be a dollar and a half for each person per day, and half a dollar for the horse. Three dollars for the steam-carriage, and thirty-five for the horse-carriage, to carry two persons three hundred miles ; of course nobody would use the horse for such a journey ; but the steam-carriage might be used with economy, either at the high speed we have supposed, or at half the speed, or less.

The estimates we have made are upon the most economical scale: the usual cost of a good two-horse carriage in the city, with the coachman, is not less than a thousand dollars per year: the steam-carriage, with an equally good man to run it, would not cost more than half that sum; and it would do its work quicker and better.

In connection with this subject it may not be amiss to state that Mr. Fisher has some views upon the subject of roads that are worthy of attention. He thinks that wooden tracks, composed of planks ten inches wide and four or five thick, with cross-pieces at the joints to support them and keep the joints even, will work well for steam-carriages. The tracks would be imbedded flush with the earth, as is usual with stone tracks, so that there would be no danger in running off, and no inconvenience in turning out.

The cross-pieces or ties being flush with the tracks, would enable the wheels to get upon the tracks again. Such roads would be cheap, but horses could not work well upon them.

We may further state, that if plank-roads were made eleven feet wide, two steam-carriages could pass upon them without either running off. The present width is eight feet. s. c.



NEW VALVE-MOVEMENT—BY J. K. FISHER.

WE wish to call the attention of the builders of slide-valve engines, especially locomotives, to the valve-movement mentioned in your last number, in the article on Mr. Fisher's steam-carriage. He has models to illustrate its operation, at 179 Broadway, which he will be happy to show to parties interested ; but for obvious reasons he does not wish to publish more about it than is necessary to induce an examination.

A brief comparison of this movement with the link-movement, which is now becoming the favorite one, will show sufficient reason to look into the matter. Taking a print now before us of Hawthorne's valve, upon his locomotive recently exhibited in the Crystal Palace, and assuming the ports to be one inch wide, we find that the throw is $4\frac{1}{2}$ inches, and the length under pressure 8 inches ; $4\cdot5 \times 8 = 36$, which represents the friction. In Mr. Fisher's, the ports of the same width, the throw is $3\frac{3}{4}$ inches, and the length under pressure $6\frac{1}{2}$; $3\cdot75 \times 6\cdot5 = 24\cdot375$, representing the friction—a fraction more than two-thirds of that of the link-movement. In the time of opening the exhaust there is an important advantage ; it is wholly independent of the time of cutting off ; and the exhaust is always wide open at the moment the crank is at the dead point, and it begins to open when the piston has run $23\frac{1}{2}$ inches, in a 24-inch stroke. In the link-movement, cutting off at 18 inches, the exhaust opens when the piston has run 22 inches ; cutting off at $16\frac{7}{8}$, it opens at 21 ; at $14\frac{3}{4}$, it opens at $20\frac{1}{4}$; at 12 it opens at $18\frac{3}{4}$; at 9 it opens at $17\frac{1}{4}$; at $5\frac{3}{8}$ it opens at $15\frac{1}{2}$. As the valve is moving at its maximum velocity when the exhaust opening commences, it is likely that the pressure diminishes so rapidly as to render the re-

mainder of the stroke incapable of more than overcoming its own friction; we may therefore consider it as lost; and we find that the comparative effects of the two movements will be as follow:

TWENTY-FOUR INCH STROKE.

Link-movement,—cut off when the piston has run

inches.	inches.
18	exhaust begins at 22
16 ³ / ₈	21
14 ³ / ₈	20 ¹ / ₄
12	18 ³ / ₄
9	17 ¹ / ₄
5 ³ / ₈	15 ¹ / ₂

In the new movement the same effect may be produced by cutting off at

inches.	inches.	saving per cent.
14.1 exhaust begins	23.92	.21
12	23.92	.29
10.4	23.92	.27
8.6	23.92	.28
7.3	23.92	.19
4	23.92	.40

In this estimate we do not allow for *any* effect of the steam after the exhaust begins to open; nor do we deduct any thing for the friction caused by compressing the steam in front of the piston, which is caused by closing the exhaust before the piston gets home. But after due allowance, which can only be guessed at, in the absence of better indicator cards than we have seen,—after a liberal allowance for the effect of the diminishing pressure during the exhaustion, we think there will remain enough to throw a doubt upon the economy of the link-movement. And were the cut-off earlier, at an eighth or a tenth, which would often be sufficient for the resistance, the disadvantage of the link-movement would be still more glaring.

In general, we may say of Mr. Fisher's movement, that the maximum velocity of the valve exceeds that of the piston, and occurs in the opening of the exhaust, and at the moment of cutting off; and that it is equally prompt at whatever point the cut-off is effected. There is no wire-drawing of any account; and if the ports were made much smaller than those in the link-movement, the effect would not be inferior to it; but this is not advisable. And as to smoothness, it is far superior to the link or eccentric, unless the joints are kept very tight. The motion, com-

mencing from rest, at the same time as the eccentric, acquires velocity very slowly at first, but attains to a great velocity as it approaches the middle, then rapidly loses its velocity, but still keeps moving until the end. It therefore cannot jolt much in consequence of a slight looseness of the joints.

COPYING ENGRAVED COPPER-PLATES BY THE ELECTROTYPE.*

ENGRAVED copper-plates are not more difficult to copy than plain ones. A plate possessing the most elaborate design, the most brilliant conception, the finest execution, the most delicate workmanship, in fact, every thing calculated to render a plate valuable, can be copied with the same readiness, the same fidelity, the same ease, as the plate without any workmanship at all; because the deposit of new metal takes place in such a way that an exact cast is made in both instances.

The design of all engraved copper-plates is in intaglio or depressed below the surface, and the problem is to obtain a duplicate in a similar state. To effect this, a reverse of the plate must first be taken in relief. This may be done in various ways. In the first place, a *relievo* may be obtained in copper, precisely in the same way as a duplicate plain plate. This is the most perfect process, and should always be adopted for very delicate designs.

An impression of a plate may be made on perfectly clean lead, by placing the lead on a printing-press, with an iron bottom, and then placing the engraved plate upon the top of it. The two are then to be run through the press, exactly in the same way as an ordinary print is taken off. In this operation, if the lead be placed underneath, a very perfect impression may be effected; but the upper plate is sure to become bent, which is a disadvantage. If the copper-plate is placed underneath, that will receive no injury, but the lead will be curled in a similar manner. Now, on considering these facts, it occurred to me, that if a third plate above the other two were employed, there would be no curling, and upon the experiment being tried two or three times, my expectations were realized, for neither lead nor copper were

* From Smee's Electro-Metallurgy.

curled to any amount. The mode in which I directed the experiments to be performed, was to place smooth lead at the bottom, then the copper-plate upon this, and lastly a third metallic plate at the top, which became curled by the process. A great disadvantage, however, in the use of lead for these purposes is, that the metal is liable to stretch unequally.

Plaster of Paris may also be used to take a relievé impression, and the stereotypers are very excellent hands at using this substance; but it will not be thought sufficiently perfect to be used for the electrotype in all cases. The plaster must be very carefully filled by the methods I have elsewhere detailed, and after the application of the black-lead it may be placed in the solution.

Having by any one of these methods taken a relievé impression, a reverse is again to be taken, in a manner similar to that pointed out for copying a plain plate.

The back of the reduced plate will be always more or less rough, which is to be filed smooth before a print is taken from it. Sometimes, when the plate is thin, a second plate of tin or iron is soldered into the back. By the use of this artificial back we can employ the crystalline copper, which is so intensely hard, that in all probability the plate would last much longer.

The front of the plate is liable to exhibit over its otherwise polished surface an appearance in copper, as if the slightest breath, or film, covered the surface. This has been technically termed "the curd," and is instantly removed by the copper-plate maker by a few slight touches with his charcoal. To account for this curd will not require much thought when we mention, that if the operator simply places his finger on a polished plate the copper reduced upon it would have precisely similar marks; and I have seen it exhibit every line of the finger, and even the opening of each perspiratory duct.

Those not much acquainted with engraving will perhaps be astonished at the various means which artists employ to execute an engraving. They may, however, be divided generally into three heads. The first contains those cases where the design is made by instruments of various kinds, as gravers, dry points, &c. In the second, the device is obtained by acting partially on the plate by acids

capable of dissolving it, or in fact by biting out the lines or figure of which the engraving is constituted. The third kind, where the surface of a plate is uniformly raised up by an instrument, in such a way that it prints all over perfectly black, in which state it is ready for the engraver. By burnishing the plate all the asperities are rubbed off, and that portion thus treated prints whiter: so that by regulating the degree of burnishing the different effects of light and shade are produced, which constitute the engraving. This is called mezzotinto. It is far cheaper than the line engraving, and is now much in vogue. Each of these three classes of engraving has been copied with the utmost fidelity, so that the application of the electrotype may be said to meet every case for which it is likely to be required.

The Art Union of London have used electro-metallurgy for their purposes. Ten different original plates were multiplied in this manner. In answer to an application on my behalf, the secretary stated that the impressions taken from each electrotype plate varied from 400 to 1000, depending chiefly on the character of the engraving, the average being about 720. They found that repairing was required to some extent in the earlier plates, but latterly it was only necessary where the plates were much undercut or burnished. The council of the society consider that for large numbers of impressions more dependence can be placed on steel plates if carefully watched while at press, than on plates produced by the electrotype.

Engraved plates were not employed till the fourteenth century, but now their uses are manifold. The great consumption now for these plates is at the potteries; for almost every common dinner-service, or every piece of pottery, has its design given by a copper-plate. The device is deeply cut in the copper, and then it is printed on a piece of thin paper; but the impression is printed with a composition of arsenite of cobalt instead of the ordinary ink. The paper is then pressed upon the pottery-plate before it is glazed, in order that the ink may adhere to it; after which the paper is carefully washed off. The pottery-plate is next glazed, and is then ready for use.

A second extensive application of copper-plates, is to be found in the manufactories of the calico-printers. They employ

copper-plates for printing their calicoes. In these instances, the copper-plate is first engraved, and bent round so as to form a cylindrical roller, and then the two edges are soldered. By contrivances the die is placed by other rollers into the hollow of the engraving, when the calico to be printed passes under the roller by the force which the roller itself exerts from the revolution imparted to it by a steam-engine. In this way twenty or thirty yards of calico can be printed in a few minutes.

In the Ordnance Map Department the plans of the maps are first drawn upon paper, from which the engravers work. The batteries are of platinized plated copper, the back and edges being very thoroughly varnished to prevent any action from the liquor. The pieces of plated copper are carefully screwed on to a frame, so that one piece of zinc can radiate to each surface of negative metal. The zincs are large cast plates, which are thoroughly amalgamated. The precipitating troughs are horizontal, and each is placed upon four wheels for convenience of moving it about. The positive pole is made of a very thick plate of copper which is placed at the bottom of the vessel, and the plate to be copied is fixed firmly to a piece of wood, which comes within a short distance in contact with the positive plate. The solution is rather diluted, inasmuch as this form of apparatus demands a somewhat slow deposit.

The object in placing the negative plate at top is to prevent any foreign body from falling upon the plate, and thus injuring the duplicate; but this course would insure a bad deposit of metal, if some contrivance were not used to circulate the fluid and cause a proper diffusion of the metallic salt continually formed at the positive pole. To effect this result, the whole trough is alternately raised up on one side and then on the opposite, which causes a little splash each time. This effect is produced by mechanical contrivances attached to the steam-engine, and appears to answer admirably.

Great care is taken to have a pure solution of sulphate of copper, with dilute acid and water, and the positive pole is frequently cleansed of that black powder which is always left upon it.

The rate of deposit in this horizontal apparatus, where the negative plate is uppermost, must be necessarily slow, but it

is stated that from one and a half to two pounds of copper were deposited upon a double elephant plate every day.

Poitevin has described a method by which we may obtain on plates raised or sunk impressions, from drawings or engravings: these plates, in their turn, may be used for multiplying the impressions. The engraving is exposed to iodine vapors, which only adhere to the black parts; the sheet is then attached to a silver plate, polished according to Daguerre's method, by means of slight pressure; the iodine is transferred to the silver, so that layers of iodide of silver are formed corresponding to the shadows of the engraving. The plate is then immersed into a concentrated solution of sulphate of copper, and used as the negative pole of a weak battery; it is removed before the iodized portions are coated with copper. The plate is at once washed, and the iodide removed by hyposulphite of soda; the copper surfaces are then oxidized by heat until they become dark brown, the exposed silver surfaces are amalgamated after cooling, and the plate being covered with two or three layers of gold leaf the mercury is volatilized by heat. The gold is brushed off from those parts which are covered with oxide of copper, and to which it does not adhere. The oxide of copper is then dissolved by a solution of nitrate of silver, and the silver, as well as the subjacent copper, exposed to the action of dilute nitric acid. The parts covered with gold are not affected, so that the etching may be carried to any depth: the plate which is thus obtained may be employed for taking impressions, in the manner in which wood-blocks are used.

In order to obtain plates engraved as deeply as the plates used for ordinary copper-plate engravings, a plate of gilt copper is employed. By proceeding as above, the light parts are covered with copper, and the shaded parts being deprived of the iodine, the gold amalgamated is removed from the shaded, and the oxide of copper from the light parts by acid. The latter will then be protected against the further action of the acid by the gold, and we obtain a deep engraving.

HORNBY AND KENWORTHY'S PATENT SIZING AND DRESSING MACHINE.

We copy from a London paper a notice of this machine, the engraving of

which will be found on page 533, No. 9, of this Magazine. The machine, we are well satisfied, is likely to be of great value to our manufacturers.

This machinery is used for the purpose of sizing, dressing, or preparing the warp threads, by causing flour paste to be combined and retained with the fibres of the threads, so that they are made more tough and smooth for weaving. In the process of the cotton manufacture, before the yarn is taken to the warping machine, it is wound from the cop on to bobbins of about four inches long and three inches diameter: these bobbins of yarn are then taken to the warping machine for the purpose of the threads being laid equally parallel to each other, so as to make them into a beamed warp, and to facilitate their arrangement after being sized and placed in the healds or "heddles" of the loom. In the old system of preparing the yarn, before its being placed in the loom, a cumbrous machine, termed a warping mill, was used instead of this improved machine of Mr. Kenworthy, which warping mill was worked by hand after the yarn had been made into a balled warp; it was then taken to the old kind of sizing machine, which soaked the yarn into the warm size, then squeezed it between iron rollers, afterwards dried it, and in the next place it was reballed. The warp was then taken from this machine for winding it on a roller-beam, after which it was removed to the looming frame, and next to the loom to be woven into cloth; but now, by the connection of Mr. Kenworthy's warping machine with the sizing machine of Messrs. Hornby and Kenworthy, the process is much simplified, and is withal systematic and mechanical. It will be seen, on reference to the warping machine itself, in the Exhibition, that the bobbins containing yarn are so placed in a wooden frame, called a "creel," that they will revolve; the threads are then passed through a "wraithe" on to a roller beam, the wraithe being required for the purpose of keeping the threads separate and uniformly in the order in which they are intended to be wound off (after having passed through the size) on to the weaver's yarn beam. In this machine is a beautiful adaptation of mechanism, by which the yarn may be

backed off the beam, if by chance any broken thread should escape the eye of the operative and get on the beam: this motion consists of a series of small cylindrical rods, so arranged that the threads of the yarn pass under them, and supposing none of the threads to break during the process, the beam would get filled without any necessity for calling this invention into action; but it so happens that breakages often do occur, and as the machine works at a rather quick speed, those severed threads get on the beam before the operative has sufficient time to stop the machine: the machine is provided with two sets of driving pulleys, one pair at each end of the driving shaft, the pair which drive the backing-off motion working at one half the speed of the other; the leathern straps or bands which connect these pulleys with the main shaft of the factory are so arranged by the one (that which drives the backing-off motion) being crossed, and the other being open, that the motion of the machine can be reversed. Whenever the threads are broken, the operative, therefore, effects the stoppage of the machine by simply passing the open strap off the fast pulley to one revolving loosely on the shaft; he then reverses the motion by passing the crossed strap off a loosely revolving pulley on to the fast pulley, thereby turning back or backing off the threads from the beam: the series of cylindrical rollers then perform their office, by moving down slots made in the framing of the machine, in their progress bearing down with them the threads backed off the beam until the severed thread is discovered and united, when the operative sets on the machine as before the breakage took place, and the cylindrical rollers to their former position. After the beam is filled by this machine, it is placed along with five others in the improved sizing machine, in bearings so that they will revolve at the left end of the machine, having weights upon their pivots, in order that they may be kept in their places; the six threads of yarn are then passed through an ordinary comb bar, or "wraithe," and thus divided equally until passed through the healds, which in this machine are situated at the left end, for the purpose of effecting the cross-shed, and thereby taking the "lease," previously to the

yarns being submitted to the sizing process. The lease now being taken, and the cross-band or threads being introduced for the purpose of "looming," or drawing in of the weaver's beam, the threads of yarn are passed over a wraith, or comb-bar, formed by a row of teeth or pins of intervening spaces, for the purpose of laying the threads in parallel breadths, side by side, and forming each division or band of threads (of any required number) into separate and distinct tapes or sheets (of any desired width), each thread being laid parallel, side by side, and thus in lateral contact, the wraith, or comb-bar, being allowed to vibrate or oscillate freely as the threads proceed. The continuous threads being thus made or separated into breadths or bands, are now passed over a conducting roller, and immersed into the trough containing the sizing material, which is here kept in a heated state by steam passing through a pipe into the trough, and thus boiled into the warp threads as they are passed through it and under the adjustable tension roller, which can be adjusted to any required degree of tension at pleasure, or can be raised up when necessary entirely out of the trough by means of a winch, worm, and rack, with which the pinions of the rollers are connected. The threads are then passed forward through a pair of squeezing-rollers, and again similarly immersed in the trough containing the size to finish the yarn, from whence they are passed around the drying cylinders, also heated by steam, and now assume the form of tapes or bands (the sizing material, by its adhesive properties, causing the threads to adhere slightly together), and thus proceed in a tape-like form, being, of course, much stronger, more regular, and less likely to be broken or disarranged than by the old mode of sizing. A circular revolving brush is placed above the threads as they proceed over the drying cylinders, for the purpose of dressing or laying the fibres, and making the tapes or bands more compact and even. They now proceed in a sized, dried, and finished state, being conducted by two rollers through a similar wraith, or comb-bar, but of much finer pitch, and by passing through which the bands of threads are passed edgewise and again similarly divided by the oscillating or vibratory

action of the comb-bar, and laid over the tension roller at the right-hand end of the machine in a proper state to be received and wound upon the warp beam ready for the operation of drawing in, after which operation it is taken to the loom and woven.

An improved self-acting marking apparatus is connected with this machine. Upon the end of one of the revolving guide-rollers is a worm, working into a small wheel on the end of a shaft, at the reverse end of which is a small mitre wheel driving a corresponding wheel upon another shaft, which carries at its other end a revolving marker, alternately dipping into a box of color, and marking the warp threads therewith as it revolves; it thus marks out any desired length of warp for the pieces of cloth intended to be woven, and allows the warp beams to contain accurate lengths without waste in the looming. The combination, therefore, of the division of the threads into bands, the arrangement of the "healds" for obtaining the cross-shed in taking the "lease," previous to dressing or sizing the new forms of "wraiths" or comb-bars, and the self-acting marker, with the improved construction of the mechanism employed, constitute an important improvement, and is of great benefit in the preparation of yarns for weaving.

The sizing machine is equally well adapted for sizing flax: it stands in about the same space as the old dressing frame, takes less power, does nearly six times the quantity of work, and is calculated for coarse or fine mule or throstle yarn, and with the assistance of a good workman will run off fully 1000 cuts per week of $5\frac{1}{2}$ days of nine-eighths wide, 66 reed, and 25 yards long.



PAPERS READ BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

1.

"ON the 'Nominal Horse-Power' of Steam-Engines," by Commander L. G. Heath, R. N.—The inadequacy of the present term, "nominal horse-power," for giving a definite idea either of the absolute or relative power of engines, was

* From the Glasgow Practical Mechanic.

first examined by comparing the engines of H. M. S. *Garland* and *Basaltisk*, which were both constructed on the same principle, with oscillating cylinders, and were both used to drive paddle-wheels. This comparison was made under three distinct heads—the mean effective pressure, the number of revolutions per minute, and the size of the cylinders. It was urged that Watt's constant of 7 lbs. per square inch, for the mean effective pressure, was not only in itself inapplicable, but that no constant quantity could be universally applicable. Also, that the method of determining the number of revolutions per minute, from a conventional speed, founded on the length of stroke of the piston, was equally fallacious.

It was, therefore, proposed that the term, "nominal horse-power," should be abolished, and that engines should in future be designated by the cubic contents of their steam cylinders, jointly with their nominal consumption of a standard description of fuel during a given period of one hour. A table might be drawn up, giving this nominal consumption in terms of the grate and the heating surface, and should be accompanied by rules and directions for insuring the uniform measurement of the grate and the heating surface. This system, it was contended, would be more in accordance with the present practice of construction, and would enable the relative size and power of engines to be more accurately estimated than by the present method.

In the ensuing discussion it was admitted, that it would be very desirable to fix the nomenclature of the power of engines; for though it was well known that James Watt did really take as his standard what he found to be actually performed by a powerful horse, drawing a weight over a pulley—viz., the equivalent of 33,000 lbs. raised one foot high in a minute—yet, commercially, it had gradually become a custom, among manufacturers, to give a surplus of power, ostensibly as an allowance for the frictions and deficiencies of the machine, so that now, the mere statement of the nominal horse-power had no definite meaning.

It was, however, contended that the standard of 33,000 lbs. should be re-

tained; and that, supposing the workmanship to be equally good in two engines, it was only necessary to compare the areas of the cylinders, the effective pressure of steam on the piston, and the speed of the piston, to determine their relative power. This was, in fact, shown by the indicator, an instrument, the value of which was now universally admitted, and which, when skilfully used, did really give a true representation of the power of the engine.

It was the universal custom of Boulton and Watt, to calculate the power exerted by an engine, by the speed of the piston, together with the average pressure of the steam, as shown by the indicator; and although much vagueness and uncertainty had laterally been introduced into the subject, this was rather to be attributed to the assumption of arbitrary quantities to represent those results, than to any defect in Watt's standard horse-power, which definitely expressed both the measure of power, and the space through which it acted.

The proposed standard of comparison of the quantity of water evaporated in a given time, by a given amount of fuel, or the combustion of a given quantity of fuel in a given time, were shown to be of no value, as then not only the generation of the steam, but the administration of it, must be considered, and these were points merely tending to complicate the question.

For pumping-engines in Cornwall, the term horse-power was almost unknown, engines being sold to raise a given quantity of water, which was a standard easily reducible to that of other districts, where 33,000 lbs. was assumed to be the actual power of a horse.

The commercial question of what a manufacturer should give as a horse-power, could not be discussed, for the actual power was only a small element in the actual cost of an engine, that varying with every peculiar application of the machine; the surplus power now given by manufacturers had evidently arisen from a more perfect machine being now produced, by the use of tools in the manufacture, the introduction of metallic rings instead of hemp packing, more perfect valves and numerous modifications, all of which were apart from, and independent of, the question of the

original standard, which, it was admitted, could not be improved, and should not therefore be altered.

2.

MR. JOSEPH WHITWORTH'S new measuring machine, for determining minute differences of length. The accuracy of the machine was demonstrated by placing in it a standard yard measure, made of a bar of steel, about three-quarters of an inch square, having both ends rendered perfectly true. One end of the bar was then placed in contact with the face of the machine, and at the other end, between it and the other face of the machine, was interposed a small, flat piece of steel, termed by the experimenter "the contact piece," whose sides were also rendered perfectly true and parallel. Each division on the micrometer represented the one-millionth part of an inch, and each time the micrometer was moved only one division forward, the experimenter raised the contact piece, allowing it to descend across the end of the bar by its own gravity only. This was repeated until the closer approximation of the surfaces prevented the contact piece from descending, when the measure was completed, and the number on the micrometer represented the dead length of the standard bar to the one-millionth part of an inch.

Eight repetitions of the experiment in a quarter of an hour produced identical results, there not being in any case a variation of one-millionth of an inch.

This method of operating was termed "the system of proof by the contact of perfectly true surfaces and gravity," and in connection with it was shown another interesting experiment.

When the micrometer was up within one division of the number where contact would be presumed to occur, the application of the finger to the centre of the steel bar sufficed to expand and lengthen it instantaneously, so as to prevent the descent of the "contact piece."

The other method of proof was by having a small, simple battery, composed of a piece of zinc soldered on to a piece of copper, and plunged into rain water, without the admixture of any acid; this was connected with the two ends of the measuring machine, and also with a delicate galvanometer. On pursuing the

same process of advancing the micrometer, one division at a time, no effect was produced, until the last millionth of an inch of distance was traversed, and absolute contact occurred with the end of the bar, when the deflexion of the needle of the galvanometer instantly detected the movement. Repeated experiments showed this to be unerring in the result, and on placing the finger on the middle of the bar, under the same circumstances, as in the other course of experiments, the expansion was instantly detected by the deflexion of the galvanometer needle.

3.

"On the Pneumatic Mode adopted in constructing the Foundations of the new Bridge, across the Medway, at Rochester," by Mr. John Hughes.—This bridge was described, as being designed to consist of three large openings, a central one of 170 feet in width, and two others, each of 140 feet in width, spanned by cast-iron segmental girders, and of a passage to admit masted vessels to the upper parts of the river, across which a movable bridge would be placed. Each of the river piers occupied an area of 1118 square feet, and rested upon a series of cast-iron cylinder piles, 7 feet in diameter, placed 9 feet apart, longitudinally, and 10 feet transversely, so that there were fourteen under each pier. The cylinder piles in the abutments were 6 feet in diameter, of which the "Strood" abutment required thirty, and the "Rochester" abutment twelve. Each pile was composed of two, three, or more cylinders, 9 feet in length, bolted together through stout flanges; the bottom length had its lower edge bevelled, so as to facilitate the cutting through the ground. The bed of the river was originally presumed to consist of soft clay, sand, and gravel, overlaying the chalk, and accordingly the application of Dr. Potts' pneumatic method for forcing the cylinder piles into the ground, which had been successfully carried out in similar positions, was contemplated; but, after a few trials, the ground was found to consist of a compact mass of Kentish rag-stone, so that the mere atmospheric action upon the piles, induced by a partial vacuum, would be ineffective in such a situation. It was, therefore, decided that the pneumatic process should

be reversed, so as to give each pile the character of a diving-bell; for which purpose one of the cylinders, 7 feet in diameter, and 9 feet in length, had a wrought-iron cover securely bolted to it, through which two cast-iron chambers "D" shaped in plan with a sectional area of about 6 square feet, appropriately called "air-locks," projected 2 feet 6 inches above the top of the cylinder, and 3 feet 9 inches below the cover. The top of each "air-lock" was provided with a circular opening 2 feet in diameter, with a flap working on a horizontal hinge, and an iron door, 2 feet by 3 feet 4 inches, with vertical hinges below the cover; each "air-lock" was also furnished with two sets of cocks, the one for forming a communication between the cylinders and the chamber, the other between the chamber and the atmosphere. Compressed air was supplied to the cylinder pile by a double-barrelled pump, 12 inches in diameter, and 18 inches stroke, driven by a six horse-power non-condensing steam-engine. At first, the expelled water was made to pass into the river, from beneath the lower edge of the pile; but when the stratum became so compact as to oppose a high degree of resistance to the passage of the air, an outlet was formed through the side of the uppermost cylinder, by the introduction of a pipe, having the form of a siphon, the long leg of which reached to the bottom of the pile, and was subject to the pressure of the condensed air on the surface of the water within, whilst the short leg, leading into the river, had the effect of relieving the amount of compression, provided a vacuum was once obtained in the body of the siphon. Such an effect was readily produced by connecting the summit with the exhaust side of the air-pumps, by a pipe which could be opened or closed at pleasure. To insure the downward motion of the pile, and to give it a weight which should be at all times superior to the upward pressure, two stout-trussed timber beams were laid on the top of the cylinder, in a direction suitable for bringing the adjacent piles into action as counterbalance weights, by four chains passing over cast-iron sheaves.

Two light wrought-iron cranes were fixed inside the cylinder, the jibs of which swept over the space between the air-

locks and windlasses, inside and outside, for the purpose of hoisting the loaded buckets and lowering the empty ones.

The method followed in working the apparatus was found to be so simple in detail as to be perfectly intelligible to all the workmen employed. The pumps being set in motion, the flap of one of the air-locks and the door of the other were closed; a few strokes compressed the air within the pile sufficiently to seal the joints, and whilst the pumping was in progress, the men passed through the air-locks to their respective stations. When the water was shallow, the pile descended, by scarcely sensible degrees, as fast as the excavation by hand permitted; but when the water was deep, the excavation was carried down full 14 inches below the edge of the pile, which then descended, at once, through the whole space, as soon as the pressure was eased off.

The most perfect certainty and success had attended the employment of this simple system.

THE DECAY AND PRESERVATION OF TIMBER.

BY SAMUEL CLEGG, JUN.

DECAY may occur in the growing tree, and is indicated by the death of the main top, and which is generally the result of the infiltration of water into the interior of the tree, by natural cracks, &c., which gradually affects the internal part of the wood, and occasions its decomposition. This extends from the heart outwards; the external, or young parts, resisting for a longer time, and hence those shells of ancient trees which we frequently meet with. The progress of this decay, undoubtedly, continues after the tree is cut down and applied to use, the order of it being still the same, the annual rings successively becoming decomposed according as they are near the centre. The whole process is slow in its operation, often requiring forty or fifty years to destroy a beam of moderate dimensions. This kind of decay is prevented by felling the tree before it shall have passed its prime.

The other kinds of decay, to which timber is liable, are termed the *common rot*, and the *dry or sap rot*.

Common rot is occasioned by alternate

exposure to moisture and dryness, and to heat and cold, therefore frequent at the part where a pile is between wind and water, or when a beam enters a wall, or at joints in framing. The progress of this decay is from the outside, hence covering the wood with paint, tar, &c., and renewing it when required, is the remedy. Duhamel found that covering *green* timber with paint or pitch hastened its decay, but painting increased the durability of well-seasoned timber. When only the external part of a beam has been seasoned, and the sap or vegetable juice (for it may not be *sap*) has not been evaporated from the internal parts, the rot will be an internal disease; hence paint prevents the evaporation of the contained moisture, and hastens decay. The same reasoning applies to the *charring* of timber, which is a very common practice for posts, &c.

The causes of *dry* or *sap rot* are inherent in the timber, and only require the concurrence of a few external conditions to come into action. Sapwood is charged with gum, starch, or sugar, with a large proportion of albumen, and other fermentable materials, a large quantity of water being also present. The fermentation excited by the albumen is of the first consequence, the agency of insects and fungi being only accessory. Insects attack wood chiefly for the sugar or gum which it contains, and aggravate the evil by hollowing out the substance and permitting the access of air and moisture; but the part performed by fungi is more obscure—they differ from almost all other vegetables in containing a large quantity of nitrogen as an essential part of their constitution; they, therefore, feed upon those substances which contain it. No fungus is ever found on a stone, or actually growing out of the earth, but always attached to some previously organized matter, either animal or vegetable, the juices of which they render subservient to their wants. The only principle common to animal and vegetable structures which contains nitrogen, is albumen, and on this the fungi prey; but the albumen must be in a fluid state, or their roots cannot take up their food. It appears, therefore, that any successful plan for the prevention of the *dry rot* must be one by which the albumen is solidified or coagulated.

The mere external application of any solution or mixture, either by steeping or painting, never can be effective in preserving wood from that decay discovered in the heart of timber. But Mr. Bethel's process for rendering wood more durable, less pervious to water, &c., consists in a mode of impregnating the wood to the centre, and saturating it throughout its whole substance with various solutions and mixtures, which have the effect of *coagulating the sap*, and thus preventing its putrefaction. But for wood that will be much exposed to the weather, and alternately wet and dry, the mere coagulation of the sap is not sufficient, for although the albumen contained in the sap of the wood is the most liable and the first to putrefy, yet the ligneous fibre itself, after it has been deprived of all sap, will, when exposed to a warm, damp situation, rot and crumble into dust. To preserve wood, therefore, that will be much exposed to the weather, or to a warm and damp situation, it is not only necessary that *the sap should be coagulated, but that the fibres should be protected from moisture*. This Mr. Bethel effects by impregnating the wood throughout its whole substance with oil of creosote mixed with tarry bituminous matters. The creosote coagulates the albumen, and the tarry and bituminous matters fill up every pore, and form an insoluble water-proof covering to the fibres of the wood. Wood that is smoke-dried is, to some extent, preserved from decay on the same principle.

All young wood receives the creosote freely, and the external part of the piles being well saturated, no worm or insect can possibly get at the heartwood; 8 lbs. of oil of tar per cubic foot suffices to preserve railway sleepers from decay. Timber intended to be prepared for permanent marine structures, should be made to absorb 10 lbs., or about 1 gallon of oil of tar per cubic foot. Timber to be creosoted is placed in a wrought-iron air-tight tank, of sufficient dimensions to receive the size required for the work, and of sufficient strength to resist a pressure of 200 lbs. upon every square inch of surface. This tank is then exhausted of air, and the liquid forced into it, and consequently into the timber, under a pressure of 150 or 200 lbs. per square inch; after it has remained in for

about 12 hours, it may be withdrawn. The timber should be weighed before being put into the tank, and again after it is withdrawn, to make sure of its having absorbed a proper quantity of the creosote.



ELECTRO-MAGNETIC MOTIVE POWER.

M. ARISTIDES DUMONT, engineer of the Ponts et Chaussées, gave, in the sitting of the Académie des Sciences, in Paris, a note on the application of electro-magnetism as a motive power.

I have the honor to submit to the Academy the results of some experiments on the application of electricity as a motive power. These experiments were made with two machines essentially different in their power and conditions of action. The first consists of a fly-wheel of cast-iron, mounted on a wooden frame. This fly-wheel is supplied on its circumference with twenty-six plates of soft iron; and between these plates are placed others of wood, to protect the periphery of the wheel from the influence of the magnetism. On the right and left of the frame I placed four electro-magnets, two on each side. Each pair of electro-magnets is placed in an opposite direction; that on the right corresponds to the centre of the two neighboring plates of soft iron, that on the left being opposite to the two wooden plates. The current of the battery is sent successively to the electro-magnets of the right and of the left by an electro-distributor, or ordinary commutator, placed on the axle of the machine.

The second electro-motive machine has a direct movement, and consists simply of an electro-magnet with its armature, which latter is attached to the end of a lever sustaining a weight. The communication or interruption of the current takes place by the movement of the armature, so as to imitate the play of the electro-trembler (*trembleur électrique*).

This second machine, as will be seen, differs from the former inasmuch as the magnetic attraction operates upon it directly, without decomposition and without loss; while, in the other engine, with soft iron plates, a part only of the

attractive power is utilized, the other component being destroyed in the direction of the axis. It is true that in practice this direct-action machine presents one inconvenience, which consists in its giving rise to an alternative movement of small extent, and consequently of difficult application; whilst the fly-wheel gives immediately, and without the intermediary of any mechanical engine, a rotary movement.

The experiments which I have undertaken were principally to ascertain the expense of production of electro-magnetic power in the present state of science, and the relations which exist, in the production of this power, between the two kinds of machines.

The battery I used was one of Bunsen's. At the beginning of the experiments, the mean weight of an element of the pile was 2·674 kilogrammes, and the weight of this element loaded was 4·338 kilogrammes; in which numbers the weight of amalgamated zinc for each element amounts to 1·228 kilogramme. By adding to 2·674, 0·320 kilogramme of nitric acid, and 1·344 kilogramme of sulphuric acid, and one-tenth of water, the whole weight is made up. The 2·674 is made up thus:

Amalgamated zinc.....	1·228
Amalgamated carbon.....	0·196
Exterior vessel.....	1·000
Porous tube	0·250

2·674

The first experiments were made with the wheel, and lasted seven hours, the battery working with sixteen elements. The development of the power per second, and in mean, was $\frac{20}{100}$ of a kilogrammetre; and the weight of zinc contained in each element was $7\frac{1}{2}$ grammes per hour. A variation was obtained within limits, extended enough, of the weights lifted, and of the velocity of lift. The maximum weight lifted was 90 kilogrammes, which showed pretty nearly the extreme limit of exertion of which the machine was capable. It results from this, admitting the law of proportionality between the power produced and the weight of zinc consumed, that the fly-wheel would consume per hour and per horse-power, 45 kilogrammes of zinc. This result proves

well enough that this arrangement, otherwise convenient enough for the immediate application of the power produced, is not advantageous enough in an economic point of view.

The experiments on the second engine were made at two different times: the first for two hours and a half, and the second for four hours. In both cases only six elements were used. In the first set of experiments, the mean power developed was $\frac{6.4}{100}$ of a kilogramme, and in the second set $\frac{7.1}{100}$ of a kilogramme; or, taking a mean of the two, $\frac{6.75}{100}$ of a kilogramme. This is a power at least three-fold more considerable than in the other engine, although only one electro-magnet was here at work, and the battery was worked with six elements instead of sixteen. This represents taking every thing proportionally as to the number of elements of the battery and electro-magnets employed, a power thirty-two times greater than in the first case.

However, the expenditure of zinc did not increase in the same ratio, for it was in the first set of experiments 10.70 grammes per hour and per element, and in the second set 14.10 grammes; or a mean of 12.40 grammes. That is to say, to produce an equal power, the second machine only consumed the fifth part of the zinc consumed by the fly-engine.

It follows from the foregoing, and taking into account the law of proportionality, that the second, or direct and alternative action machine, consumes per hour and per horse-power only 8.280 kilogrammes of zinc, which is the basis taken to establish the actual cost of electro-magnetic power.

The necessary expense of supplying one of the elements employed in the several experiments is 1.20 fr. (12d.) These elements can work at least eight hours without removing the acid; and the expense in this interval for zinc, acid, amalgam, and handiwork, will be 0.272 fr. (2 $\frac{3}{4}$ d.) as a mean. This will give per hour and per element 0.34 fr. (3 $\frac{1}{2}$ d.) Our second machine does not, therefore, expend more than 20 centimes (2d.) per hour, at the outside, to produce a mean power of $\frac{6.7}{100}$ of a kilogramme per second.

A like power, though very small, might nevertheless be usefully turned to account in many trades where only slight efforts

are needed, and where the most desirable result is to produce these efforts instantaneously and irregularly, or, as we may say, at will, without any sensible loss resulting from this irregularity. This, it is well known, is not easy to be effected with steam, which requires expensive apparatus, and which is often inconvenient for small trades. To give an example from the foregoing facts, it may be observed that the power of $\frac{6.7}{100}$ of a kilogramme, produced by the second machine with six elements, and with an expense of 18 centimes per hour, would be enough to raise to a height of 20 feet, and with one hour's work only, the water for a household of four persons, reckoning 60 litres per head per day.

From these experiments I make the following deductions:

1st. That electro-motive power, without admitting at present of comparison in the production of great power with steam, either as regards the absolute value of the power, or in an economical point of view, does admit of being usefully and practically employed in some situations. It is quite true that the cost of the electro-magnetic power is 20 fr. (16s. 8d.) per horse-power per hour, and that the cost of steam would be 1d. per horse-power per hour, or only $\frac{1}{200}$ of the cost of the electric machine.

2d. That although not admitting of competition with steam for high powers, electro-magnetism can compete with it for low powers and in small trades.

3d. That electro-magnetic power does not compete with steam, but may be successfully used, as it were, in carrying out its use.

4th. That electro-magnetic engines, with different and alternate movements, have a great superiority over rotary engines.

5th. That with the former engines, the influence of currents of induction seems less than with rotary engines.

6th. That, to produce the power stated, the expense is only 3 centimes per element per hour, or 18 centimes per hour with six elements.

Lastly. That from the calculation of expense is to be deducted the value of the sulphate of zinc produced; and, likewise, it is to be borne in mind that the same expense will provide power and light.

ON THE APPLICATION OF ELECTRO-MAGNETISM TO LOCOMOTIVE ENGINES.

THIS interesting invention by Messrs. Amberger, Nickles, and Cassol, has made the subject of a memoir by Mr. G. Love, C. E., presented to the Society of Civil Engineers of Paris in the course of last June. A discussion was immediately opened upon the subject, a detailed account of which was given at the time by the *Annales des Chemins de Fer*, and the *Journal des Chemins de Fer*. The communication was received with feelings of great interest by many of the members present, but three of the engineers opposed strongly the memoir, so far even as to deny altogether facts which the author and many others had been, for a long time, accustomed to look upon as established. In consequence of this Mr. Love felt himself obliged to submit to the society another memoir, in which he investigated more completely the facts previously disputed. The effect of this new memoir was such as the author wished to produce, viz., to determine one of those engineers whose high position on railway working lines should allow it, to take the invention in hand and try it on a large scale. Mr. Sauvage, an eminent government engineer, who has the management of the locomotive department on the Paris and Lyons railway, kindly offered the inventors the means of putting their invention to the test of experience, and they have now been engaged for upwards of a month in preparing the apparatus and engine, with which a decisive experiment will shortly be tried.

The principal object of this notice is to give an abstract of the last memoir; with the hope it may induce practical men to look candidly on the new invention, which seems to us to promise, even in its infancy, to bring important changes in locomotive engines, and also in the construction of railways.

Amongst the objections made to the first memoir was one which, if it had been true, would have proved the impracticability of ever using electro-magnetism to increase the adhesion of the working-wheels of a locomotive engine. It may be useful to remind our readers here in a few words, that the invention consists in a long wire of copper, clothed

with silk, and so disposed as to make a great number of circumvolutions round the lower part of the wheel without touching it. When a current of electricity produced by a battery of Buntzen is allowed to run through this wire, or *coil*, the part of the wheel which comes in contact with the rail is transformed into an artificial loadstone, the well-known property of which is to adhere strongly with iron. This in consequence produces an increase of adhesion, the value of which, it is easily understood, can be varied at liberty, according to circumstances. The same battery, when not used to give adhesion, may be turned to act on an iron break, which comes down on the rail like that of Mr. Laignel, and produces powerful friction without the least combination of levers or gearing. A break made on that principle has been lately adapted to a wagon of the Great Western Railway, and it was a matter of no little astonishment to witness the force it displayed, although a very small part of it was touching the rail on account of it being rather out of shape. Now the objection alluded to was this: the wheel electro-magnetized being in contact with an indefinite length of rails, and these touching the earth by a great number of points, there will be a loss of fluid, such as to reduce nearly to nothing the increase of adhesion; or a most powerful battery, and consequently a very large expense will become necessary to increase it to an efficient and useful degree. This, however, Mr. Love showed to be wholly unsound. We proceed to give a short account of the other objections, which were, in the whole, a mere denial of the following propositions:

1st. The adhesion of locomotive engines is frequently insufficient. It is not in proportion with their power.

The maximum of adhesion generally corresponds to the greatest effort the engine is capable of producing at the circumference of the driving-wheels, and it is calculated to be about the one-fifth of the weight incumbent upon these wheels. But we know well this quantity of adhesion may, according to the state of atmosphere, go down so low as to become only the one-fifteenth or even the one-thirtieth of the said weight, so that the quantity of adhesion the engine *can pro-*

vide varies within considerable limits, entirely out of the control of the engine-man. Now the adhesion the engines *must provide* varies also within tolerably extensive limits, according to the weight of the train, the speed, and the degree of inclination of gradients. Hence, we understand, that it may occur, and indeed it does occur frequently, that the engine can only dispose of a very small quantity of adhesion when the maximum should be required, a circumstance which creates delays, collisions, and at least puts the companies frequently to the extra expense of auxiliary or pilot engines.

Here we find in the memoir a table in which the author gives numerous instances of engines belonging to French railways, with the necessary quantities of adhesion they require on a gradient of 1 in 200; in consequence of their usual speed and the weight of the trains they are calculated and frequently called upon to drag. He has placed opposite the quantities of adhesion, *maxima* and *minima*, these engines can provide according as circumstances are favorable or not, and it is shown by this table that the *required quantity* of adhesion is often double of the quantity that an engine can dispose of.

The conclusion that may be drawn is, that an engine cannot be held to possess a sufficient quantity of adhesion unless her *minimum* should be equal to the *maximum* she may be called upon to provide. It is evident that an engine placed in such a condition might do her full duty in spite of the slippery state of the rails caused by the fog or rain, or other circumstances. But it is equally evident, that such a result could not be aimed at, unless her weight should be increased enormously, far beyond what may be necessary for the strength of her pieces.

2dly. The insufficiency of adhesion is one of the causes of the limitations of the gradients in the construction of railways.

The power of an engine is such that it would enable her to climb up very steep gradients, provided the speed should vary properly in an inverse ratio; but it must be observed that the steeper the gradient is the greater must be at the same time the *necessary quantity* of adhesion, so that this quantity draws nearer

and nearer the maximum the engine can dispose of in the most favorable circumstances, as the gradient goes on increasing. But we know very well that the only quantity to be depended upon is her *minimum*. It insures that increasing the steepness of gradients is increasing in a great proportion the chances of stoppages, collisions, or extra expenses of auxiliary engines, inconveniences that a wise engineer will avoid as much as possible in reducing the gradients, and making tunnels or deeper cuttings, &c.

3dly. Electro-magnetism taking away all uncertainty on the quantity of adhesion that may be obtained to meet what may be required at any time, will be the means of adopting steeper gradients, and, consequently, of reducing considerably the cost of railways.

This requires no further demonstration: we shall content ourselves with this remark of Mr. Love, that many secondary lines, where speed is not so much wanted, and which could never be thought of being undertaken before, will be easily made with very little expense compared to what should have been necessary with the limited gradient now adopted on most railways.

4thly. Electro-magnetism may also be of great service to lines opened to traffic.

We can see at once, for instance, that the connecting-rods of coupled engines, which are in the eyes of all practical men a bad and dangerous system for obtaining the necessary degree of adhesion, will be done away with. There will be no longer any necessity either to fix, in bad weather, those barbarous and absurd sand-boxes in front of the driving-wheels, which, if they get by these means the adhesion required, project the sand into all parts of the mechanism, and wear it out rapidly. Besides, coupling being dropped entirely, companies will soon find a good saving in the maintenance of the roads, which, everybody knows, suffer a good deal from that system. Another cause of rapid destruction of the roads, and breakage of rails, is the enormous weight that acts on the driving-wheels. With electro-magnetism weight being no longer a necessary condition for adhesion, that of an engine will be distributed as equally as possible on the three pairs of wheels, and besides the advantages derived from thence for the

maintenance of roads, it will permit engineers to limit themselves, in future, to rails of moderate size and weight.

5thly. The principle by which adhesion is now obtained is the most serious obstacle to a more extensive application and improvement of railways and locomotive engines.

Indeed, what sort of improvement may be wished in the new system of roads? One of such a nature as would permit the application of them to those countries, the hilly constitution of which threatens them with being deprived of railways forever; and we see at once that this desirable object can only be attained in making *cheap railways*, and cheap railways can only be made with *steep gradients and light rails*: and who does not perceive that the present *uncertainty of adhesion* and the *enormous weight presently required* on the driving-wheels, is a complete bar to that progress?

Again, what improvement should be looked for in locomotive engines? It would be very desirable that an engine could produce a less costly power, that its weight should be reduced a great deal. But the principle of adhesion is such, that it forbids altogether to seek for the means of diminishing the weight of engines and *profit of an invention* that would place in our hands too light an apparatus producing cheaper force. Thus, the discovery of Mr. Boutignies, which, it is thought, will permit the construction of boilers of a very little weight compared to those now in use, and giving *dry steam*, compressed air cylinders, machines put in motion by electricity, &c., all these inventions, which it is not unreasonable to expect will be brought one of these days to a practical form, must be laid aside as long as we stick to the *principle of weight* for adhesion.

Mr. Love concludes with the observation that it is very seldom that an idea, however good, comes to a shape useful to industry as long as it remains in the hands of theoretical men. Thus, steam would still lie asleep and useless in Papin's Digester, if practical men had not taken it from the hands of the most learned people. What has occurred for steam will no doubt be again the case for electricity. Up to to-day this powerful fluid has only been studied in cabinets of physics, and for a long period of time the

only things that have issued from that source are the electric telegraph and a great number of scientific playthings. The time is not far off when the highly interesting problem will be solved—Shall electricity take the place of steam?

PHILLIPS' FIRE ANNIHILATOR.

WE extract from the Journal of Commerce the following article, written by a friend of ours, for whose discriminating judgment in matters of practical utility we have every respect.

It is now several months since a letter from London, published in one of our city journals, announced that some distinguished and wealthy gentlemen had purchased at a very high sum the right to this invention in the United States, and that it was to be brought before the American public under high auspices. The letter further stated that the Fire Annihilator had been adopted by the British government and various municipal authorities, &c., in Great Britain, and further went into some particulars of its efficacy in certain fires in the great metropolis.

Having myself had some experience with the Annihilator, and having derived therefrom the belief that it would never be a useful invention, I felt surprised at this announcement, yet presumed that the apparatus had been subsequently improved, and that Mr. Phillips had succeeded by experiment in bringing out something new and useful, under which hope I waited for the introduction of this triumph in science. In the course of time the plans of the company were made public under the guarantee of Hon. Elisha Whittlesey, President. Hon. Jno. M. Clayton, Counsel, and P. T. Barnum, Esq., General Manager and Secretary, names well known to the public, and from whose declarations no due credit could be withheld. In this advertising pamphlet, the American Company set forth in harrowing words the manifold means by which the fiery demon destroys hundreds of human lives and obliterates millions of property from the face of the earth and sea. But the selection of the annexed rhapsodical paragraph will best set forth the philanthropic sentiments of the company.

"Let us glance at the ship, solitary and, alone upon her foam-path on the ocean. Let us look at the steamer, cleaving her way over seas and lakes, with hundreds of human beings in her grasp, and the fire-fiend carefully watching, night and day, for a moment's inattention, in order to sweep the whole into an agonizing and inevitable grave! Let us look at the flame-tongues licking up, with an unearthly roar, every vestige of life and beauty, and hearken to the piteous cries of the helpless, as they are tauntingly mocked by the wind-echoes, or copied in the far-off shrieks of the frightened sea-bird!" "Let us bring all these images of painful reality before our mental eyes, and then turn a single look upon the humble, quiet-looking, diminutive machine, which, in an instant and at comparatively little expense, could have averted all this dreadful evil."

With such an exordium before me, I could but look upon, indeed up to, the directors in this enterprise as public benefactors; and have from week to week and month to month waited for the promised exposition in our city, where men who saw must believe. I did think a delay might have been unwisely occasioned by a desire to give unnecessary eclat to the recent fair of the American Institute; but the fair has passed and we have had no trial of the Annihilator. Why have they not given us the unadulterated thing by setting free the vapors into some of the genuine fires which almost nightly occur in our midst, and thus save property and test the machines on one and the same occasion? We are told of various causes for the delay, but as I apprehend the gentlemen engaged in this speculation have reasons for holding back for some of the improvements not yet consummated, I have determined to say something about what I have myself seen of this invention.

In the year 1845, I was invited by Mr. Phillips to be present at an experiment with his Fire Annihilator apparatus in London. After an appointment a week in advance, I proceeded, with a friend, to the place of rendezvous. I found Mr. Phillips, with his assistant, waiting for us in a kind of kitchen in the rear of a dwelling-house,—an area or yard about 30 feet square intervening between the kitchen and the house. A large fireplace in the kitchen was filled with light

pine wood, over which had been thrown profuse sprinklings of tar and rosin. The Annihilator chosen was of the largest size then made (about 30 inches high and 10 inches diameter); a smaller apparatus, dissected, was shown, to explain the principle of the machine. I suggested to Mr. Phillips that the instrument seemed too frail for the great internal pressure it would have to sustain when in action; but he assured me I was quite wrong, as there was no possible danger, he never having experienced any accident, although he had made repeated trials with the machine. My confidence being thus assured, I took my stand near. Mr. Phillips ignited the combustible in the fireplace, and the whole mass was soon in a most terrific, roaring blaze. He then took the hose, and was about to fire the machine, but I desired him to stop, as the wood was not burning, it being simply the gas from the resinous matter which was in flames. This he did not heed, but struck the button of the instrument, and seized the conducting tube, which he directed on the fire. In an instant the vapors rushed from the pipe with considerable force, when I observed to him that it was steam, and he was blowing out the flames; but at this point, say half a minute after igniting the mass within the machine, the Annihilator exploded with a most violent report; the entire place was filled with fire, steam, and smoke; a large portion of the machine passed with shot-like speed a few inches from my head, and I was showered with burning matter almost like melted glass. I with difficulty got out of the door into the yard, and rushed for the door into the house, where I found a servant inside, holding the door with his whole might, declaring it should not be opened. At the same time I shouted for my friend, whom I had seen leave the door before me. In the confusion I at last heard his voice, and found he had fallen backwards over, and behind some boxes next the wall. On rushing to him I was joined by the assistant, and we helped him up. On regaining his feet, he asked, "Where is that thing?" "What thing?" was the answer. "Why the A-n-n-i-h-i-l-a-t-o-r!" "It has bursted," said the assistant. "Well, it chased me twice round this yard, and run me into this hole here," replied he. And there was no doubt of

it, for we found the inner cylinder near him, which being charged with highly inflammable matters, had, rocket-like, shot out of the door, and striking against the wall near the angles, bounced about until its contents were exhausted, and the case heated to a red heat and battered like tea lead. We again made our way to the door of the house, and after much persuasion induced the man there to let us in. To our inquiry for the cause of his conduct, he said he had had enough of that business, and had long expected the house would be burned up from the accidents. We were shown into a room, where water was brought us to cleanse our blackened figures. My two coats were burned through, and even my under garments set on fire; my neck, face, and hands sadly burned. The assistant, who had accompanied us, stated that it was not true that accidents were unfrequent, and that shortly before, an apparatus of like size had burst in the open air, and been thrown entirely over a house into a neighboring garden. My friend replied that as the thing had nearly annihilated him, he had had enough of it, and we took our departure, finding a large crowd about the door (attracted by the report and smoke within) as we passed to our cab, truly glad to escape with our lives.

I find on inquiry that the Fire Annihilator has undergone no changes or improvements since, and I will further state,—1st. That it is not a safe machine except in experienced hands, even if made strong enough to prevent an explosion.

2d. That there is no fire-destroying gas generated by the composition; but that the vapor of water is generated by the heat, which vapor, if directed on the flame in sufficient volume, will destroy the flame, but not extinguish the fire.

3d. That the instrument in itself is dangerous, as it may be exploded from design, from accident, from curiosity, and set fire to the building it was designed to protect.

4th. That in the show-off experiments got up to puff the invention, the parties usually fire resinous matter, the gas only of which burns, while the solid matter is to a great extent unharmed.

5th. That if this invention possessed a tenth part of the merit claimed for it by its American proprietors, the Fire Department of London, and the Insurance Com-

panies there, would have long since given it their support; and the much honored and efficient veteran chief of the British Metropolitan Fire Brigade, Mr. Braidwood, would long since have extended to Mr. Phillips the cordial hand of confidence; and until this can be certified I shall feel that it is not yet time for the adoption of the invention in the United States.

FIRE ANNIHILATOR.

To the Editor of Appletons' Mechanics' Magazine and Engineers' Journal.

SIR: Your remarks on Phillips' Fire Annihilator seem to confound things essentially different. The real subject under consideration is the extinguishing of fires by incombustible gas, and not the character of Barnum & Co. There can be no question as to the abstract possibility of extinguishing fires in this way: whatever you, on the one hand, or Barnum & Co. on the other may say, this *fact* remains unassailable. I do not wish to appear as the apologist of the mode in which they are attempting to introduce this improvement in extinguishing fires; nor do I particularly admire their chemical philosophy. (What, in the name of common sense, has plaster-of-Paris and steam to do with incombustible gas?) But I wish to place the question on its true merits, and to point out that the problem to be solved is a simple matter of cost. Can incombustible gas be produced so cheap as to sometimes supersede the use of water? This is the issue, and this alone. The following remarks are intended to throw some light on this point. My plan would unquestionably supersede its use in incipient fires, and may hereafter, when we become accustomed to its use, be of very important service in arresting large conflagrations. I would premise that the extravagant notions of some can never be realized, such as that the largest fires can be extinguished by it without the aid of fire-engines. For when the large timbers are burned to a coal, and the bricks, &c., red hot, the decomposition of the combustible materials will proceed without interruption in generating gas, which will instantly ignite if it is not prevented by the presence of some incombustible gas. Now in many instances it would

take hours or days before the burning mass would be so cooled that decomposition of the materials of the building would cease, and consequently if fire-engines were laid aside, the incombustible gas must be applied incessantly during the whole of this time; whereas water, judiciously applied, would accomplish the object in a few minutes.

The province of the fire-engine is to cool the red-hot embers, while the province of the fire annihilator is to stop the ignition of combustible gases. When the two are worked together, each in its own peculiar mode, we shall obtain a control over this terrible destroyer which has hitherto been impossible. But unless the ridiculous pretensions which have been put forth are modified, a sad revulsion will take place after a few failures; and it will require years of slow, indefatigable working by its real friends to remove the outcry of humbug which will be raised. It is reasonable to expect that failures will occur. There never yet has been a new invention introduced but that the carelessness of some, or the stupidity of others, would cause some mishaps. The extinguishing of flame by incombustible gas is no novelty at all; everybody knows it is a philosophical experiment, but it is only recently that the idea has been entertained that it could be so abundantly and cheaply made as to be available to arrest the flames of a burning building. Any chemist would suppose *à priori* that carbonic acid, or nitrogen gas, would be the most available; but there is another gas, the binoxide nitrogen, which is as effectual as those named.

These, then, being the gases which would appear to be the most suitable, the next point is to ascertain from what source they can be most readily obtained; now the requisite conditions of being cheap, easily manufactured, and readily brought into use, are admirably united in a combination of nitrate potassa with some combustible material containing hydrogen, such as the various forms of vegetable fibre, in the shape of wood-straw, &c. When the salt is intimately mixed with either of these substances, the following changes take place on the mixture being fired: 3 equivalents of the oxygen of the nitric acid unite with sufficient of the carbon of the woody fibre to form carbonic acid gas; while a part of

the oxygen is retained by the nitrogen of the acid, and forms binoxide nitrogen; but if the heat generated be very intense, some of this also will be decomposed, nitrogen gas being separated, and the oxygen uniting with the carbon present to form carbonic acid. The gases then formed by this means are carbonic acid, nitrogen, and binoxide nitrogen, with a small quantity of steam from the hydrogen and oxygen which exist in woody fibre in the proportion to form water. The potassa is left a deposit unaltered.

Now comes the question, Can these gases be produced by the means stated, in sufficient quantity to be of service in extinguishing a fire? The shortest way to answer this question will be to state the quantity of nitrate potassa required to be used to extinguish flame in a given space. (I take this salt as the basis of my calculations, as the volume of the incombustible gas used is obtained from it exclusively; the carbon which combines with its oxygen does not increase its bulk, it only adds to its weight.) From a variety of experiments I have ascertained that one ounce volatilized by the means previously stated, will destroy all flame in about twenty cubic feet of space. Now, a medium-sized room will contain about 1200 cubic feet, which, according to the ratio above stated, will therefore require about 4 lbs. nitre to render the existence of flame within it impossible; but supposing in practice it should take a much larger quantity, arising from the gas escaping through chimneys, broken windows, &c. It must be evident to every one, that the necessary quantity of it can be easily obtained, and that at so cheap a rate as to bring it within the reach of every one, and allow of its most liberal use without any great cost, for although I cannot say what would be the exact price of the article, manufactured for sale on a large scale, it is obvious that the nitre will be the most expensive part, and that certainly is cheap enough.

The following plan will answer to try the experiment on a small scale: Dissolve one pound nitre in five half pints hot water; then dip any kind of paper into the solution, and when well wetted hang it up to dry, and when dry it is fit for use. Then take a tight barrel, open at one end, turn the open end down so that it will lay close and tight to the

ground, put under it a lighted lamp and some of the saturated paper, then apply a match to the paper, and your light will be extinguished in a few seconds. Have another light ready, and as you turn the barrel up put it into the barrel among the gas, and that also will be extinguished. Or the experiment may be tried in this way: place some of the saturated paper into a deep jug and set fire to it, have two lights at hand, and when the gas ascends hold one of them in it, and when it is extinguished relight it by your spare lamp, and try the experiment over till the paper is consumed, and then try if a lighted lamp will live in the jug.

To those who doubt that a few pounds of nitre decomposed by the means stated can have a power sufficient to accomplish so much as is here claimed for it, I would say, whence comes the roar of the cannon, the crack of the musket, and the low rumbling of a gunpowder explosion? Why, it comes from decomposed nitre. The inventor of gunpowder saw that nitre was admirably adapted for the purposes he had in view, and any candid mind must admit that it is also admirably adapted for the purpose I have in view; and I think I am fully justified in saying that he had no greater right for claiming it as a mighty engine of destruction, than I have for claiming it as a powerful means of extinguishing flame. Had both these ideas been started at the same time, one would have appeared as profitable as the other; and it may be that the new use to which it can be applied would prove as beneficent, as its previous use has been destructive. C. DOWDEN.

Our correspondent's objections to considering the character of the advocates of a new invention, as bearing upon the value of the invention itself, are to a certain extent reasonable.

Our convictions, however, of the utter worthlessness of this Annihilator are strong, and rest upon other evidence than that afforded by the manager's known reputation for exhibiting manufactured curiosities; yet notwithstanding this, we consider our object will be much better served (and certainly as well understood), by endeavoring to lead the public to examine for themselves before purchasing

machinery at the American Museum, than by talking of nitrate potassa, carbonic acid gas, and binoxide nitrogen; all very well in their place, but not very convincing in print.

The experiments detailed are interesting, but valueless, in our humble opinion; and for the following reasons; which sum up our objections to relying upon any other element than water to extinguish fire.

If you rely upon incombustible gas, you must generate it in such quantities, and *with such force*, as to set at defiance the diluting effect of the atmospheric air which will rush in from all points wherever a fire is raging.

If you rely upon steam (which we maintain is the principle upon which the annihilator is designed to operate), it is only effectual when present in such force and density as absolutely to take the place of the atmosphere; and extinguish the fire for lack of air to support it.

If you will calculate the power requisite in either case, you will find the present fire-engine a mere toy to the machine which would master the conflagration of a three-story house well in flames.

The advocates of the annihilator have fallen back a little from their first position, and now say that it is useful in the early stages of a conflagration—to be kept in every house to put down the enemy while he is feeble and may be mastered.

This is all very well for the sale of the machines; but the advice to keep a quart of water within reach is far more reasonable; for there never was a fire yet that a quart of water would not have extinguished in its incipency; and that, too, without giving you a chase around the yard (see the experience of our friend, page 760), whereas the annihilators in this country are not warranted as secure, unless built at the Novelty Works; and whether the latter are successful as chasers, remains to be seen.

PATENTS.

List of Patents (with claims annexed) which issued from the United States Patent Office from the 15th day of July, 1851, to the 22d day of July, 1851.

TO STILLMAN A. CLEMENS, of Springfield, Mass., for *Improvement in Machines for dressing Sisal, Hemp, &c.* Patented July 15, 1851.—I claim the hinged jaw connected with the driving-shaft, substantially as described, in combination with the cylinder to which it is hinged, and provided with a corresponding jaw substantially as described, whereby the driving power, in carrying around the substances to be dressed, clamps and holds them firmly during the entire operation.

I also claim, in combination with the cylinder and clamp for presenting and carrying around the substances to be dressed, as described, the knives and combs attached to one or more hinged bars, and provided with the necessary means for operating them.

I also claim, in combination with the cylinder, as described, the vat of water in which, at each rotation of the cylinder, the substances to be dressed are immersed.

TO SAMUEL G. DUGDALE, of Richmond, Indiana, for *Improvement in Churns.* Patented July 15, 1851.—I claim the application of the spring-wire, which connects the crank with the dashers, in the manner and form and for the purpose set forth.

TO OLIVER N. FRENCH, of New London, Conn., (assignor to himself and EBENEZER STEVENS, of Hopkinton, N. H.,) for *Improvement in Axle-Boxes for Journals for Railroad Cars.* Patented July 15, 1851.—What I claim is to support the case on the bearing by two projections, or analogous contrivances, applied to its sides, in combination with making the top plate of the case and the cap or side plate in one piece, separate from the rest of the case, and holding them in place by recesses and projections, or analogous contrivances, the whole being to enable me to entirely dispense with the use of the screws or nuts in the construction of a railway-car axle-box, and thereby avoid not only the injurious consequences which frequently result from their becoming loose, but also the necessity of that care and attention on the part of the car-man or attendant so necessary when boxes are used having any of their parts secured by screws.

TO GUSTAVUS L. HAUSKNECHT, of New Haven, Conn., for *Improvement in Carriage Springs.* Patented July 15, 1851.—I claim the employment of a semi-elliptical spring, in combination with a C spring formed by the extension of one of the arms, the combined springs thus produced being set transversely with the axle and attached thereto, and the body of the vehicle in the manner described.

TO HARMON HIBBARD, of Henrietta, N. Y. (assignor to JARED A. HIBBARD, of the same place), for *Improvement in Buggy-Tops.* Patented July 15, 1851.—I claim the mode of connecting carriage-tops with the seats by

means of the bearers and clasp, so that they may with facility be removed from one carriage-body and applied to another.

TO LEWIS LILLIE, of Troy, N. Y. (assignor to JOHN W. BATES, of same place), for *Improvement in Fire-Proof Safes.* Patented July 15, 1851.—I claim the combination of wrought and cast iron, the same forming a safe in the manner described.

TO D. C. McCULLEN, of Oswego, N. Y., for *Improved Means for adjusting the Effective Length of Bridge Counter-Braces.* Patented July 15, 1851.—I claim the method of lengthening or shortening the counter-braces of a girder, or bridge-truss, so as to produce and maintain any desired vertical strain or deflection of the girder or truss by means of the counter-brace, whether all of wood or provided with a metallic end or sheath; the plate of metal bearing upon the metallic end or sheath (or upon the end of the wood, when the metallic end or sheath is not used) at the top of the girder, and the nuts and the bolts passing through the clamping pieces, the upper cords, and the posts, by which the plate of metal is drawn down upon the metallic end or sheath, and the adjustment of the length of the counter-brace is effected.

TO SYLVANUS MILLER, of Urbana, Ohio, for *Improved Rake to Harvesting Machines.* Patented July 15, 1851.—I claim the guide, arranged as described, in connection with the tilting roller, for the guidance of the rake in a path similar to that which it would receive from the human hand, by which it removes periodically the grain or grass from the bed, and frees itself by the retraction of the teeth of the rake endwise.

TO WILLIAM E. MILLIGAN, of New York, N. Y., for *Improved Arrangement of the Flues and Water-Spaces of Steam-Boilers.* Patented July 15, 1851.—I claim the general arrangement of the tubes and flues of the boiler in the manner described; that is to say, the water tubes connected with an upper and lower tube sheet, in combination with the flues of less length than the tubes, which flues are also connected with an upper and lower flue-sheet, whereby two horizontal flues are formed in such connection with each other by means of the vertical flues, that the product of combustion from the fireplace shall pass into the upper horizontal flue, and thence down the vertical flues into the lower horizontal flue; having thus the facility of parting with its heat on the one hand by radiation through the flues to the water-spaces surrounding them, and on the other through the tubes to the water circulating through those, and this whether the said tubes and flues are placed vertically or horizontally.

TO WILLIAM PANTON, of Milton, Mass., for *Improvement in Machines for Splitting Leather.* Patented July 15, 1851.—I claim as my improvement in machinery for splitting or dressing wet hides, the employment of an elastic surface-roller (or roller made of gum-elastic, or other like material, placed around an axle or shaft), and an inelastic roller (as

feed-rollers) in connection with the cutting-knife, made either stationary, or, what is better, to have a vibratory or reciprocating motion.

To ERASTUS STEBBINS, of Chicopee, Mass., *for Improvement in Molasses Gates, or Faucets*. Patented July 16, 1851.—I claim the arrangement of the spring which bears the gate against the seat (said spring being arranged so as to bear against the outer edge instead of the central part of the gate), in connection with making the said gate separate from the lever, and to work on a projection or screw therefrom, as specified.

To JAMES WARNER, of Springfield, Mass., *for Improvement in Revolving Breech Firearms*. Patented July 15, 1851.—I claim the arrangement for securing the barrel to the stock, viz., the combination of the stud with the notch in the back strap, and with the notch and pin.

To DENNIS WOODCOCK, of Independence Centre, N. Y., *for Improvement in Machines for Sawing and Dressing Staves*. Patented July 15, 1851.—I do not claim the use of a cylindrical saw, as such has frequently been used, but I claim the employment of the saw seated loose upon a pulley, so as to form an eccentric position with the same as specified, in combination with the cutters, the several parts constructed and operating together.

To JOHN J. RIDDLE, of Covington, Ky., *for Improvement in Brick Machines*. Patented July 22, 1851.—I claim the block or lip, hugging closely the mould wheel, immediately behind its point of contact with the pressure roller, in order to prevent any disturbance of the mass, after having passed the point of contact.

To GEORGE H. THATCHER, of Albany, N. Y., *for Improvement in combined Fountain and Evaporator*. Patented July 22, 1851.—I claim constructing a vase or other like article, with two apartments or chambers, having a continuous as well as a periodical communication with each other, by which it is rendered a self-supplying evaporating fountain, the continuous communication of the lower chamber with the upper apartment or evaporator, being effected by the pressure of steam upon the surface of the water in the lower chamber, and the periodical communication by means of the valve secured in the screw nut, which will be opened by the pressure of the accumulated water in the upper apartment, when relieved of the pressure of the steam in the lower chamber.

To JOEL V. STRAIT, of Litchfield, Ohio, *for Improvements in mode of changing Reciprocating into Rotary Motion*. Patented July 22, 1851.—I claim, first, the employment of curved or inclined forks (four), having a reciprocating, rectilinear movement, operating on or operated by cams (three), in the manner set forth.

Second, the use of cams constructed or attached so that they may be turned or set, in order to produce a change in direction of the motion, and acting in connection with forks or their equivalents.

To JOHN JONES, of Clyde, N. Y., *for Improvements in hanging Carriage Bodies*. Patented July 22, 1851.—I claim the manner herein described of raising the body on to the springs, or lowering it on to the reaches, as may be desired.

To WM. & WM. H. LEWIS, of New York, N. Y., *for Improvement in Buffing Apparatus for Daguerreotype Plates*. Patented July 22, 1851.—We do not claim heating the buffer, as that has been done by lamps operating on the plate on which the buffing material is stretched, but in that form the heat is uneven, and the vapor from the spirit lamp is liable to come in contact with the buffing material. But we claim the inclosing drum, constructed with the sliding segment or cover, flanch, and lip sliding in the grooved plate and retained by the spring for the purposes specified, in combination with the drum and pipe to pass the heat from a spirit lamp or other heater to the drum, for the purpose of heating the buffer; the drum being fitted with a pipe, or other means, for passing vapor from the spirit lamp, outside the case inclosing the buffer.

To CHARLES W. STEARNS, of Springfield, Mass., *for Improvement in Faucets*. Patented July 22, 1851.—I claim the application of a hollow conical packing around the waist of the valve stem, in combination with an open space between its lower end and the stem, the interior of the tubular projection being smooth, or of such form as to allow a tight joint between it and the conical packing.

Designs.

To SAMUEL A. HOUSE, of Mechanicville, N. Y., *for Design for Stoves*. Patented June 24, 1851.

To ELIJAH P. PENNIMAN, of Rochester, N. Y., *for Design for Stove Plates*. Patented July 15, 1851.

To APOLLON RICHMOND, of Providence, R. I. (assignor to A. C. BARTOW & Co., of the same place), *for Design for Plates of Parlor Stoves*. Patented July 15, 1851.

Re-Issue.

To E. S. CLAPP, of Montague, Mass., *for Improvement in Fastenings of Scythes to the Snath*. Patented March 18, 1851. Re-issued July 8, 1851.—I claim, first, the mode of attaching and securing the blade of the scythe to the snath, substantially as herein specified, to wit: by clamping its shank between an edge of an aperture in the end of a metal cap secured to the snath, and two bearings or points on the opposite side of the shank and on opposite sides of the first-named bearing point, one of the two bearings consisting in a screw or its equivalent, for the purpose of giving the necessary pressure to clamp it.

Second, the method substantially as herein described, of setting the edge of the blade, move up or down by means of the adjusting screw, in combination with the edges of the aperture, which forms one of the three bearing points of the shank.

List of new English Patents, from September 4th to September 25th, 1851, both inclusive.

John Wallace Duncan, of Grove-end-road, St. John's-wood, gentleman, for improvements in engines for applying the power of steam or other fluids for impelling purposes, and in the manufacture of appliances for transmitting motion. September 4; six months.

Henry Alfred Jowett, of Sawley, Derby, engineer, and John Kirkham, of Peckham, Surrey, engineer, for improvements in hydraulic telegraphs and in making signals. September 4; six months.

John Poad Drake, of St. Austell, Cornwall, for improvements in constructing ships and other vessels, and in propelling ships or other vessels. September 4; six months.

Dominique Julian, of Sorques, France, for improvements in extracting the coloring properties of madder, and in rendering useful the water employed in such processes. September 4; six months.

Baron Charles Wetterstedt, of Grosvenor-street, Commercial-road, for improvements in preserving animal and vegetable substances. September 4; six months.

William Imray, of Milton-road, Liverpool, for improvements in the manufacture of bricks. September 4; six months.

Timothy Kenrick, of Edgbaston, Warwick, iron founder, for improvements in the manufacture of wrought-iron tubes. September 4; six months.

Benjamin Hallewell, of Leeds, wine merchant, for improvements in drying malt. September 4; six months.

Pierre Armand Lecomte Fontaine-moreau, of 4 South-street, Finsbury, for certain improvements in preserving animal substances from decay by means of a composition applicable to the cure of certain diseases. September 4; six months.

Gail Borden, Jun., of Galveston, Texas, in the United States of America, manufacturer, for improvements in the treatment of certain animal and vegetable substances, to render them more convenient for use as articles of food, and for their better preservation. September 5; six months.

John Blair, of Irvine, Ayr, North Britain, gentleman, for certain improvements in beds or couches and other articles of furniture. September 11; six months.

John Rowland Crook, of Birmingham, hatter, for improvements in hats, caps, and bonnets. September 11; six months.

David Main, of Beaumont-square, Middlesex, engineer, for improvements in steam-engines and in furnaces. September 11; six months.

William Jean Jules Varillat, of Rouen, France, manufacturing chemist, for improvements in the extraction and preparation of coloring, tanning, and saccharine matters from various vegetable substances, and in the apparatus to be employed therein. September 11; six months.

Alexander Parkes, of Birmingham, Warwick, chemist, for certain improvements in the manufacture of copper, and in the separation of some other metal therefrom, and in the production of alloys of certain metals. September 11; six months.

George Phillips, of Upper Park-street, Islington, Middlesex, chemist, for preventing the injurious effects arising from the smoking of tobacco. September 18; six months.

John Wormald, of Manchester, Lancaster, maker-up and packer, for improvements in machinery or apparatus for spinning and doubling cotton, wool, silk, flax, or other fibrous substances. September 18; six months.

John Simpson Leake, of Whitehall Salt Works, Chester, manufacturer, for certain improvements in the processes and machinery or apparatus employed in the manufacture of salt. September 18; six months.

John Livesey, of New Lenton, Nottingham, draughtsman, for improvements in the manufacture of textile fabrics, and in machinery for producing the same. September 18; six months.

Frederick Hale Thomson, of Berners'-street, Middlesex, gentleman, and George Foord, of Wardour-street, in the same county, chemist, for improvements in bending and annealing glass. September 25; six months.

Charles Green, of Birmingham, Warwick, for improvements in the manufacture of brass tubes. September 25; six months.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., of Fleet-street, London, patent agents, for improvements in presses and in pressing. (Being a communication.) September 25; six months.

Robert Roberts, of Dolgelly, Merioneth, mine agent, for an improved method of quarrying certain substances. September 25; six months.

Charles Watt, of Kennington, Surrey, chemist, for improvements in the decomposing of saline and other substances, and in separating their component parts, or some of them from each other; also in the forming of certain compounds or combinations of substances, and also in the separating of metals from each other, and in freeing them from impurities. September 25; six months.

James Garforth, of Dukinfield, Chester, engineer, for certain improvements in locomotive steam-engines. September 25; six months.

David Stephens Brown, of the Old Kent-road, Surrey, gentleman, for an improved agricultural implement. September 25; six months.

Ernst Kaemmerer, of Blomberg, in the kingdom of Prussia, iron-founder, for his invention of improvements in sowing, depositing, or distributing seeds over land. September 25; six months.

NOTICES AND CORRESPONDENCE.

THE *London Mechanics' Magazine* we have been so accustomed to regard as standard upon all questions appertaining to the mechanic arts, that it is with extreme reluctance we venture to dissent from the views of its editor upon any subject.

We recollect very many years since, before the present deluge of "scientific periodicals," so called, the pleasure with which we greeted its green covers, and the almost religious veneration with which we regarded the dictum of its editor, whenever, at long intervals, he condescended to thrust in his pen and with a few happy strokes, settled the business for a pair of wranglers who had had each other by the ears for the space of two or three numbers. We never thought to have lifted our sacrilegious pen against his venerated head, and had the possibility of such an event been suggested to us, we should have been inclined to have said with some one not recollected just now: "Is thy servant a dog that he should do this thing?"

Judge, then, of our astonishment on finding this morning two several statements in his September number, to each of which we are forced to withhold our entire assent.

It seems at a sailing match lately held somewhere near his island home; a crack yacht, built upon what the savans of that island are pleased to call the *wave principle*, was lately beaten by one from this side the water; which boat, it now appears from the above authority, "*was built upon the same principle.*" And the same learned authority adds:

"The merit of this theory of construction is ours; that of best carrying it out is alone what belongs to our transatlantic friends."

We had thought, considering all the circumstances, that the result of the race was a pretty decided evidence of superiority somewhere. We are pleased to learn that the boats were built upon the same principle of lines. It leaves the merit of success entirely due to our superior *seamanship*; for the rigging of a craft, as well as the sailing, is an essential branch of seamanship. If it be more gratifying to the English pride to be beaten in seamanship than in building; our transatlantic friends are welcome to all the consolation the facts of the case afford them. But of one thing we are pretty certain; that the builder of the America was as much guided by an English theory of ship-building in modelling her hull, as he was by the English practice of rigging in proportioning her spars.

Again: in noticing the remarks of a correspondent, who takes occasion to say that he had "yet to learn what Mr. Fulton really invented which has benefited the world," the editor mentions his having repeatedly shown that *Symington was undeniably the first to demonstrate the practicability of propelling vessels by steam*; but adds, "that Fulton did even more than Symington towards bringing steam navigation into general use."

The latter statement is correct; but the former, as to Symington's claim to having demonstrated the feasibility of navigation by steam, is, we are constrained to say, not entitled to the consideration which usually attaches to the opinion on professional matters of our learned and respected contemporary.

In what we are about to offer we must not be understood as endeavoring to enlighten the English public on this subject. Their peculiar belief in this matter arises less from want of light, than from wilful blindness, as we must call that which rejects as evidence, the proof on record adverse to the claim of Symington.

We will not weary by examining early evidence of priority of *suggestion*, for this latter cannot be called invention. Every claim prior to 1784 must be rejected, for the simple reason that the steam-engine of Watt was before that day unsuited to the purposes of navigation, by reason of its incapacity to perform a continued rotary motion. The suggestion to use such a machine could not entitle any one to being regarded as the successful pioneer in steam navigation.

The fact that the power of steam was available for the purpose of navigation was demonstrated in this country as early as 1785. Fitch's boat was built and run on the Delaware as early as 1785 or 1786, and accomplished four miles per hour, but he used paddles instead of wheels; and however his experiments were suggestive to others, they were not followed up by the immediate introduction of steam navigation.

Miller, of Dalswinton, in Scotland, was a wealthy man interested in mechanical pursuits, and amongst other things, had amused himself on a pond in his

neighborhood with a pleasure-boat, propelled by paddle-wheels turned by hand. A tutor in his family by the name of Taylor, suggested the use of steam to drive these wheels; and in the autumn of 1788, Symington, an engineer, who was experimenting with land engines in the neighborhood, was employed to put one of them into this boat. The English are pleased to say that "this happy trio produced the modern steam-ship."* The experiment was perfectly successful, and, "having satisfied its projector, the engine (four-inch cylinder) was removed into his library at Dalswinton-house, where it stood for a long time as an ornamental model."

A larger engine was built the next year by the same gentleman for the Clyde Canal, and was said to have made seven miles per hour—a satisfactory experiment.

"The vessel (we transcribe from the English account) being a slight skiff of plank, less than one inch thick and incapable of permanent use, as soon as the experiments were over, was replaced as a pleasure-boat on Mr. Miller's property, and the engine deposited at Carron works." Symington's next boat, built for Lord Dundas, was on the same canal, in 1802, after the interval of a dozen years; but, from some cause, the project was again abandoned.

These experiments with model boats are considered by the English as establishing their claim to the *successful introduction of steam navigation*.

If a man should make what he considered an unsuccessful experiment, and abandoning his project, leave to more enterprising men the discovery and the proof, that in truth, he had been on the right track, to whom, we ask, should the award be given?

That the experiments were, from some cause, considered failures, we may infer from the fact, that the models were laid up, and nothing grew out of them, whilst the individuals making them were known as men of wealth and enterprise; and we may well ask, why, if these experiments were so perfectly successful, did not these three inventors of the art at once introduce it into practical use, as the means of inland transport, and derive from it the mercantile benefit due to the inventors of a new mode of commercial intercourse?

We find in an English work* advocating the claim of these men to being considered the projectors of steam navigation, an anticipation of this question, and an apology for them, which is in itself sufficient evidence that they did not of themselves introduce steam navigation:

"Why should Mr. Miller, a patriot, it is true, but a man now advanced in life, retired from business to the *otium cum dignitate* of his country seat, to the pursuit of agricultural recreations, and the education of his family, why should he spontaneously plunge into a war with the prejudices of the world, and the encumbrances of involved speculation? And Mr. Taylor—what could the poor family tutor do to accomplish that which his master, who had the wealth, had not the hardihood to encounter? And Mr. Symington, whose profession it was to apply the steam-engine, who was poor and isolated, and without the assistance of enlightened enterprise and

* Steam and Steam Navigation, by J. S. Russell, p. 191.

large capital, what could he do more to produce a revolution so gigantic? Mr. Miller felt that he had done all that his duty to mankind required when he put them in possession, by publication, of what he had done. Finding also, that in the experiments he had already made on various subjects for the public welfare, he had expended above £30,000, which other men might have thought it their duty to bequeath to their family, he felt it to be his duty, after having advertised the public of the success of his attempts, to leave that public fully at liberty to avail itself of all that had already been accomplished whenever it should think proper to do so."

A philanthropist and patriot truly! This is the English claim to the successful introduction of steam navigation. The first steamboat in operation in England was in 1812, five years after Fulton had established his line of boats to Albany.

Wherever Fulton obtained his notions of the feasibility of navigating by steam, he need not have travelled out of this country to obtain them; nor do we believe he did; as it is a matter of record, that Fulton exhibited in court the proof of having submitted to Lord Stanhope a plan for steam navigation, substantially the same as the one he finally adopted, *six years prior to Symington's experiment on the Clyde*. However that may be; we merely claim for Fulton what all unprejudiced minds will admit—that the merit of being a public benefactor rests not with the man who dreams, speculates, and experiments; but with him who actually confers the good by putting us into possession of the results of his sagacity and enterprise. That this will be accorded to Fulton, and that his name will live long after that of Miller, Symington, and Taylor shall have been forgotten, we do not doubt. English writers, it is true, dwell with great satisfaction upon this still-water-paddling of Miller and Symington; but we had looked to the editor of the *Mechanics' Magazine* as one who too well understood the difference between speculation and reality, and too fair to attempt claiming for his countrymen a merit to which they were not entitled.

It would appear that the claim urged for Englishmen in each of the cases alluded to above is the same. The merit of the theory and suggestion is (by their own statement) theirs; while they grant us the successful practice. Admitting all they claim, it still leaves for us the greater honor; and this we wish our mechanics to bear in mind.

FROM the Bibliographical Notices of the November number of the *Journal of the Franklin Institute* we select the following:

Appleton's Dictionary of Machines, Mechanics, Engine Work, and Engineering. Illustrated with 4000 Engravings on Wood. Edited by Oliver Byrne. New York: D. Appleton & Co. 1850. 8vo. 2 vols.

"We are glad to see this very valuable compilation at length completed, and still more glad to find that it maintains its character for fulness and accuracy to the last. We regard it as decidedly the most valuable and reliable book of the kind in the English language. Mr. Appleton has had the good fortune to secure the services of an editor fully fitted, as well as by his talents and education as by his energy and indefatigability, for the task; while his familiarity with the science of other countries, led him to avoid the great fault of English Encyclo-

pedias, their confinement to English results. Mr. Byrne has done justice, to a great extent, to all, and in consequence, the state of general practice on any subject is better represented in his book than in any other that we know of. We observe, however, with surprise, that the last number of the second volume is accompanied by new title-pages for both volumes, in which the name of the editor is altogether omitted. What is the meaning of this? If, as would appear from such examinations as we have been able to make, and from what we learn in other ways, Mr. Byrne is the one who has compiled and written the work—which is, in every fair sense of the word, a new one—he certainly is entitled to have his name on the title-page, and to receive credit for what he has done, and this is accorded in the old title-pages, which are now, however, replaced by new ones. We cannot, at present, imagine any state of circumstances which would justify an act of this kind; but Mr. Appleton certainly owes it to the public, to state his reasons for what appears to be an injustice, and we hope that those who have subscribed to the work will have it bound with the older and correct titles. "F."

We find in the title-page of the "Practical Model Calculator," now being published by Baird in Philadelphia, the following: "Edited by Oliver Byrne, Civil, Military, and Mechanical Engineer; Compiler and Editor of the 'Dictionary of Machines, Mechanics, Engine-work, and Engineering;' author of 'The Companion for Machinists, Mechanics, and Engineers;' Author and Inventor of a *New Science*, termed 'The Calculus of Form,' a substitute for the Differential and Integral Calculus; 'The Elements of Euclid by Colors;' and numerous other Mathematical and Mechanical Works; Surveyor-General of the English Settlements in the Falkland Isles; Professor of Mathematics, College of Civil Engineers, London."

Now, we have as little objection to Mr. Byrne calling himself editor of Appleton's Dictionary of Machines, &c., &c., as we have to his calling himself "Surveyor-General to her Majesty's Possessions in the Falkland Islands;" but we trust that he has a better claim to the latter title, than to the first. In the month of June, 1850, we were invited by the Messrs. Appleton to take the entire charge of the editorial department of their great Dictionary, then in progress, and published as far as the letter F. Mr. Byrne (whom we have never met) ceased to have any control over the work after this date, and we commenced our editorial duties with the letter G. and after sixteen months labor brought it to completion.

That our own name did not appear on the covers of the work as it issued from the press was entirely owing to the circumstance that as the Dictionary had then a large circulation, and known as Byrne's Dictionary of Machines, &c., the publishers, (for obvious reasons) did not think they were called upon to publish the fact of a change in the editorial department, but finally withdrew Mr. Byrne's name from the cover or the numbers; and at our own instance substituted their own in its place. There being a manifest impropriety in issuing to the public, as edited by a gentleman a volume with which he had no connection, will sufficiently account for Mr. Byrne's name not being inserted in the *Second* volume, however he might have been entitled to

that consideration in the First. *We* were not ambitious of having edited *half* a book—hence, declined the honor of appearing on the vacated title-page of this same volume; and if the Messrs. Appleton saw fit to publish their Dictionary without acknowledging the editorial labor expended upon it, no one should complain so long as *we* were content.

We have trespassed upon the patience of our readers with no intent to magnify our own merit, but to vindicate the Messrs. Appleton from the charge of injustice implied in the above extract from the Journal of the Franklin Institute.

A NEW Method of Calculating the Cubic Contents of Excavation and Embankment by the Aid of Diagrams, by John C. Trautwine, C. E.

That branch of the profession engaged in Railroad construction are again indebted to this accomplished engineer for the means of reducing the labors of the office as well as the field. We took occasion the last month to notice a work by Mr. Trautwine on Railway Curves, as the best practical work on the subject probably in print. We are pleased to see that the onerous labor of estimating cubic contents have received a like share of attention from him; and the result is, a book on this subject that while it facilitates the work of estimating, at the same time insures accuracy; two functions scarcely reconcilable by any other method. Every young engineer or person designed for the engineering profession, should be in possession of both these little volumes.

THE Drawing Class of the Engineer's Institute is now open for the admission of members and apprentices, at their rooms No. 151 Bowery, on Tuesday and Friday evenings. Charge to members, \$4 per quarter; apprentices, \$3. The class is well attended, particularly by apprentices, and is a means to improvement in an essential branch of education, which our young mechanics should not neglect.

WE hasten to lay before our readers what we will not say is *better* than anything we have before given them, but which is certainly worth to them the whole price of the Magazine for the last year.

TO GET RID OF COCKROACHES.—Mr. Samuel Tewkesbury, of Nottingham, in a letter to the *Manx Sun*, says, "I beg to forward you an easy, clean, and certain method of eradicating these loathsome insects from dwelling-houses. A few years ago my house was infested with cockroaches (or 'clocks,' as they are called here), and I was recommended to try cucumber peelings as a remedy. I accordingly, immediately before bed-time, strewed the floor of those parts of the house most infested with the vermin with the green peel, cut not very thin from

the cucumber, and sat up half an hour later than usual to watch the effect. Before the expiration of that time the floor where the peel lay was completely covered with cockroaches, so much so, that the vegetable could not be seen, so voraciously were they engaged in sucking the poisonous moisture from it. I adopted the same plan the following night, but my visitors were not near so numerous—I should think not more than a fourth of the previous night. On the third night I did not discover one; but anxious to ascertain whether the house was quite clear of them, I examined the peel after I had laid it down about half an hour, and perceived that it was covered with myriads of minute cockroaches about the size of a flea. I therefore allowed the peel to lie till morning, and from that moment I have not seen a cockroach in the house. It is a very old building; and I can assure you the above remedy only requires to be persevered in for three or four nights, to completely eradicate the pest. Of course it should be fresh cucumber-peel every night."

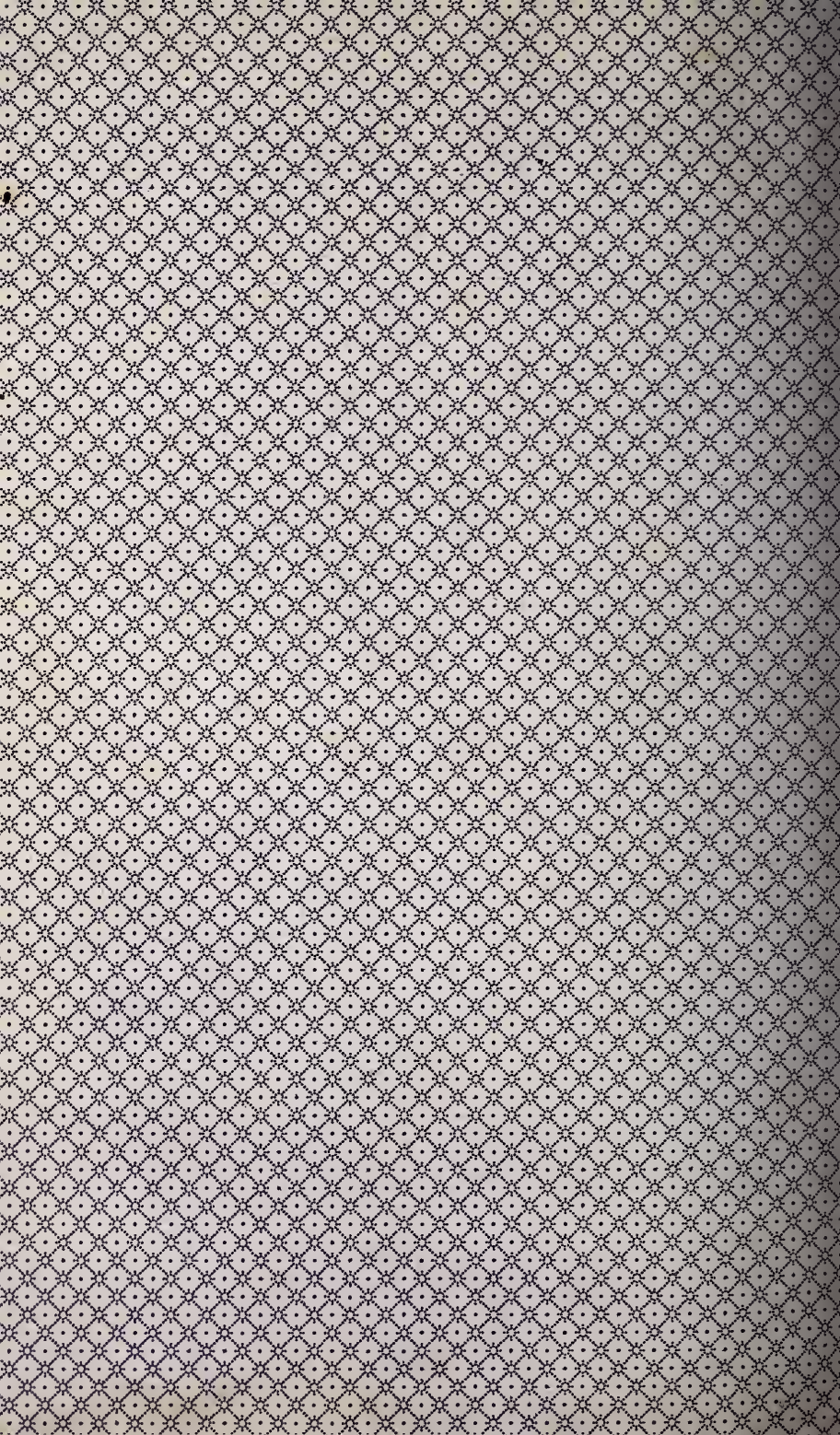
THE secretary of the Wacamahagas (for whom, by-the-way, we entertain a most profound respect, the fruit of an acquaintance of many years' growth) has interested himself so far in our Journal as to promise for publication the debates and transactions of their society.

That our readers may appreciate the extent of this bequest, we will merely state. That the society, consisting of practical engineers, have long been organized for their mutual improvement, the results have thus far been so happy upon themselves, that, with a benevolence much to be admired, they are desirous of extending as far as they may to others, the benefits resulting from their labors. That they should have selected this Journal for the medium or vehicle between themselves and the public, is alike creditable to them, as us. The name of the society, we ventured to say, was by no means a happy one, in, that it is inexpressive of the aim and object of the association; but we are assured that there is a meaning in it, and that the Tribe from whence the name is derived, were especially distinguished above all others, for the very qualities which confer individuality upon this association.

As this was the only explanation which the Grand Sachem deigned to give, we were constrained to be content therewith; and shall look to hear from them, without again questioning their right to call themselves by what name they please; 'tis not with names, but *things*, we have to do.

"AMATEUR." Day & Newell's Lock will be forthcoming.

 It would give us great pleasure to notice, under a proper head, such periodicals as may be received in exchange for the Magazine; but only such can be noticed as are sent to the *Editor's address*.



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